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THE NEUROPHYSICAL ASPECTS OF THERAPY IN CEREBRAL PALSY

TEMPLE FAY, M.D., F.A.C.S.

Director, Neurophysical Rehabilitation Clinic, Chestnut Hill

PHILADELPHIA

In my opinion, the field of cerebral palsy has become the outstanding challenge of the day, not only to those who may be interested primarily in the causes and prevention, but to the large groups of physical therapists who find specialized training and postgraduate study necessary to carry on this phase of the handicapped and crippled children program.

It has become clearly apparent after several medical conferences by those who have pioneered various branches of cerebral palsy[1] and after the recent survey held by the United States Children's Bureau[2] (where representatives from almost every aspect of the field were brought together to discuss the problem), that specialized forms of physical therapy offer the best means of treatment at our disposal for the child with cerebral palsy today.

Surgical corrections, both orthopedic and neurosurgical, offer only limited possibilities in specially selected cases. Drugs have real value only as adjuncts to physical therapy and proper correctional measures under careful medical supervision.

The special application of physical therapy principles necessary in the accepted treatment of patients with cerebral palsy has required from three to six months of postgraduate training at rehabilitation centers, such as have been developed in Cockeysville by Dr. Winthrop M. Phelps from the orthopedic standpoint; at the Bellevue Hospital, New York, by Dr. George G. Deaver from the vocational rehabilitation standpoint, and in Philadelphia from the neurologic and neurophysical standpoint. A rotational system of training has been devised, whereby those undertaking the major term of their study at one clinic may have an opportunity of spending a portion of their time observing the work in another.

The physical therapy measures used in the treatment of cerebral palsy are entirely different from those concerned with the principles involved in disease or injury to the spinal cord and its roots. In the latter group (poliomyelitis is the most familiar type), paralysis, contracture and occasional spinal types of spasticity are the only factors involved. The state of the muscles and their intrinsic neuromuscular and metabolic manifestations are usually peripheral problems concerned with circulation and nutrition. Of course, the altered effects on the bony levers that move the extremities and the resultant deformities and handicaps which may result, due to disturbed balance among themselves, and the various physical vectors that no longer give efficient response are problems for the orthopedist and the specialist in correctional support and activity.

The problems of cerebral palsy include paralysis, spasticity, rigidity, ataxia, tremor and incoordination, with multiple combinations depending not only upon loss of voluntary power but also upon the disturbed sensory modifying influences of position sense, vestibular and visual aids to balance and the antigravity factors that make upright positions such as sitting and walking possible. In addition to the problems of the extremities, there are

1. Joint Conference of the Medical Advisory Council for Cerebral Palsy Division, National Society for Crippled Children and Adults, Inc., 1947.
2. Conference on Cerebral Palsy of Medical, Nursing, Educational and Therapy Representatives, held under the direction of the chiefs of the United States Children's Bureau, Federal Security Agency, March, 1947.

also speech, hearing, visual understanding and mental defects which frequently further complicate the picture.

The physical therapist who deals with these patients must be familiar to some degree with all these modifying factors if treatment is to be effectual.

There are certain neurologic points of view that are important to the physical therapy specialist. The meaning and value of postural reflexes, reactions of defense, tonic neck reflexes and pattern movements, which are all vital considerations in the majority of patients suffering from cerebral palsy, should be familiar at least in their clinical aspects.

The neurologist has known for many years and classified the various reflex responses which have, for the sake of convenience, been grouped under the general heading of (a) superficial, or skin, reflexes (such as the abdominal reflex); (b) deep tendon reflexes (such as the patellar or Achilles reflex); (c) tonic, or postural, reflexes (such as those seen in the tonic neck reflex and reflexes of spinal automatism).

Organic lesions involving the pyramidal tract give rise to the symptoms of paralysis, increase of reflexes, spasticity, ankle clonus and the sign of Babinski. In addition to the alteration of the normal responses to the deep tendon reflexes, there may appear various degrees of so-called reflexes of spinal automatism. These have been referred to as defensive reflexes by Babinski. Such reactions of defense are frequently seen in a spastic extensor type of paralysis when stimulation of the lower extremity by pinching, scratching, sudden passive flexion of the toes or lateral compression of the foot is applied. The leg is usually drawn up suddenly in a movement of tonic reflexion, or shortening, of the lower limb at all the joints, including flexion of the hip and knee, with dorsiflexion of the ankle and toes, especially the hallux.

In cases of spinal paraplegia, of profound midbrain lesions and occasionally when injury to both surfaces of the cerebral hemispheres involving the motor area has occurred, such sudden violent drawing up of the lower extremities in flexion, may be associated with extreme pain and discomfort to the patient, and the source of great difficulty to the therapist in attempting to control such reflex reactions.

If this type of defensive mechanism on reflex is elicited by bending the toes down quickly and at the same time pressing the knee outward gently, a full and spontaneous flexion of the leg and knee will occur (fig. 1). When

Fig. 1. — Reflex of defense, produced when the toes are bent downward and inward. The movement is spontaneous in a person with spastic paralysis; it is associated with full flexion of the knee and relaxation of the adductors.

Fig. 2. — Full relaxation of the adductors in spastic diplegia can be obtained by flexion of the toes and inward rotation of the foot on both sides.

this type of response is viewed with the patient placed on the abdomen, it will be seen to resemble part of a "pattern movement" which is characteristically amphibian in type. If viewed with the patient lying upon the back, it has little or no significance. When the lower extremities are suddenly flexed in this manner, the adductors become relaxed, so that the extremities may assume the position of the frog preparatory to a leap (fig. 2).

This so-called defense reflex is similar to that described by Sherrington, who obtained the "flexion" reflex, the "extensor" reflex and the "crossed" reflex when the spinal cord of the dog was cut in the upper cervical region or when the pyramidal pathways of the brain stem were cut at the level of the midbrain, producing what is known as the decerebrate animal. These various simultaneous and sequential responses of "spinal automatism" are probably portions of a larger mechanism, known as a pattern movement.

Pattern movements involving the homolateral extremities — that is, a forward thrust of the hand and foot on the same side alternating with a similar movement of the opposite side — constitute the mechanism of crawling, seen at the early level of the amphibian (fig. 3) and finally perfected in the crossed type of progression pattern seen at the level of reptilian evolution and familiar to all in the progressive movements of the alligator, the lizard and the turtle (fig. 4).

Fig. 3. — Amphibian type of pattern movements, showing homolateral extension of upper and lower extremities. The head is turned toward the advancing upper extremity, and the thumb points toward the teeth or eyes. As an extremity is pushed downward in the act of progression, the head turns toward the advancing extremity, initiating a pattern movement. This is probably the basis for the tonic neck reflex.

Fig. 4. — Crossed pattern of reptilian type, the upper extremity on one side and the lower extremity on the other being advanced simultaneously. The head and eyes are turned toward the advancing upper extremity and away from the side of propulsion progression. Crossed patterns are similar to the final pattern of crawling and eventual walking or marching, with the synochronized coordination of the extremities.

In mammals such as the horse, the difference in the pattern of progression may be threefold, trotting, pacing and galloping. The bilateral movements of the lower extremities in unison in the last pattern can be seen at the amphibian level, as the leaping response of the frog is probably a precursor to the galloping movements of the mammal. In this pattern movement, the lower extremities are simultaneously flexed and extended, chiefly for the purpose of propulsion. These movements are of spinal origin, as is known from observations on the pithed frog.

In the past, these basic reflexes of automatism have been considered an undesirable problem that plagued the therapist as well as the physician-in-charge. Organization of these reflexes and the utilizing of them for purposes of developing muscles, relaxing antagonists and coordinating tone have, however, indicated that it is an "ill wind that blows no good"; these reflexes themselves are now being elicited to benefit the patient and, in many instances, have been made to fit into a total pattern movement of amphibian or reptilian type, with great improvement in spasticity and even emerging into partially controlled coordinated movements in the paralyzed part at times.

The tonic neck reflexes described by Magnus and deKleijn and recently elaborated by Gesell[3] are probably responses which belong to the upper portion of a segmented "pattern movement" seen in the embryonal amphibia and first noted by Coghill,[4] whose observations on ambloblastoma revealed that the earliest movements of the nervous system in this form were those of turning the head, neck, and eyes toward the extended upper limb bud (extremity) even before the extremity had become fully developed. The eye-head-neck-tail reflex, being a vermicular sort of movement, first progresses down the segments of the embryo trunk, and later, when the limb buds are evolved into paddles for propulsion, the initiation of the reflex causes a forward thrust of the upper extremity during the vermicular wave which progresses to the caudal end pole of the animal, giving rise to the characteristic twisting snakelike movement seen in the polywog or the newt.

This eye-head-neck-tail movement is frequently seen in a portion of its manifestation in the early phase of a convulsive seizure, when the head and eyes may be turned sharply to one side, the patient later assuming a decerebrate type of rigidity, with the trunk included in the mass reflex which precedes the colonic movement that later appears in the extremities.

In all probability, the tonic neck reflex, as well as the various combinations of isolated forms of spinal automatism, belong to the serialized pattern movements of the early fish forms of life which established amphibian characteristics when they evolved fin-limb appendages to propel themselves in an eel-like fashion over the surface. It is seen in the later stages of the reptile and the mammal that the bone muscle structures have become highly specialized extremities.

The attempt to rationalize these various types of reflexes or responses with the patient lying upon the back is confusing, but when the patient is placed on the abdomen with the head and neck turned to one side and the upper extremity advanced toward the eyes of that side there is frequently an associated drawing up of the lower extremity on the same side, or there may be the crossed (contralateral) reflex seen in pattern movements at the reptilian level with flexion of the opposite knee.

Many patients started on the homolateral pattern movements rapidly perfect these and almost without further instruction advance or graduate into the more complicated "crossed" pattern types, which ultimately become the basis for the true coordinated patterns of walking. This utilization of pattern movement for retraining and recoordinating the muscle groups in cases of cerebral palsy has already been fully discussed elsewhere.[5]

From the neurologic aspect, a child suffering from cerebral palsy may be paralyzed from the standpoint of voluntary movement and yet retain many spontaneous reflex pattern movements in the extremities. These are similar to the movements noted by Sherrington in the decerebrate animals. Voluntary, skilled and intelligent movements arise at the cortical level, and, because the cortex may be damaged to various degrees in cerebral palsy, the problem of retraining and reeducation has been considered more or less hopeless when these cortical areas have been shown by pneumoencephalography to be permanently lost.

The fact that many pattern movements of complicated types and extent still persist in the lower motor levels of the midbrain, the medulla and the upper cervical and thoracic portions of the cord seems to have escaped at-

3. Gesell, A.: The Tonic Neck Reflex in the Human Infant, J. Pediat. 13:155, 1938.
4. Coghill, G. E.: Flexion Spasms and Mass Reflexes in Relation to the Ontogenetic Development of Behavior, J. Comp. Neurol. 79:463, 1943; Correlated Anatomic and Physiologic Studies of the Growth of Amphibia, ibid. 64:135, 1936.
5. Fay, T.: Observations on the Rehabilitation of Movement in Cerebral Palsy Problems, West Virginia M. J. 42:77, 1946.

tention but nevertheless offers a challenge to the therapist to determine whether it is possible that certain automatic spinal reflex activities can be organized and coordinated with what remains of higher cortical centers (either crossed or uncrossed) to bring about a pattern movement to assist in whatever motor activity the patient may perhaps utilize with the aid of braces and proper exercises of balance and other coordinated activities, to enhance or restore a useless part. For instance, if the right upper extremity still has good movement and some voluntary response to cortical control (left motor arm and hand center intact) but the left side is paralyzed and both lower extremities are spastic, it may be possible to initiate a crossed pattern movement and train the coordinated existing responses of the right upper extremity to set up homolateral or crossed spinal responses to aid the other uncontrolled and paralyzed parts. The level of the medulla and spinal system below may not be able to react to the voluntary initiation of a stimulus from the higher cortical levels, whereas if posture is properly conditioned by the labyrinth and tone, reflex and muscle responses are conditioned by repetitive training "new" movements may appear in an otherwise useless limb. The time and practice involved is no different from that required to retrain the hypoglossal nerve to move the lips instead of the tongue after paralysis of the facial nerve has made a hypoglossal-facial anatomosis necessary.

Specifically, if the patient is unable to voluntarily make the movements of the left lower extremity from the wishful cortical level, there can be initiated a crossed pattern type of movement which, if trained and augmented, will greatly assist in possibilities of progression of this part, through the existing mechanism of spinal automatism.

During repeated observations on the clinical values of pattern movements, the simple reflexes of defense just described, have been found to be a valuable adjunct toward decreasing spasticity and relaxing adductor spasm as well as giving an excellent exercise value to the paraplegic muscles.

Most physical therapists in exercising a spastic lower extremity will grasp the dorsum of the foot with the fingers around the ankle and, placing the other hand beneath the leg at the level of the knee, induce flexion and extension by passive movements (fig. 5). If such manipulations are carried out in a direct vertical plane, whether the operator is standing at the side of the patient or at the foot of the table, the movements are more or less piston-like, but flexion and extension are produced only after overcoming the stretch reflex, by repetitive upward and downward thrusts, and a clasp-knife effect is noted with each individual effort.

However, where the extensor type of spastic paralysis exists, particularly in a patient with spastic diplegia with scissors gait or posture (fig. 6), if the therapist will grasp the toes and quickly flex them passively and at the same time, with only the slightest amount of effort, rotate the knee outward and guide the flexion at a plane approximately 30 degrees to 45 degrees from the vertical (fig. 7), it will be found that the leg will be spontaneously and quickly flexed on the hip (spinal automatism), the adductors relaxed (fig. 8) and the foreleg flexed at the knee. With the simultaneous pressure on the toes and guiding of the knee outward to a proper angle of flexion, the extremity is usually drawn well up on the hip, giving the muscles the best type of exercise and allowing all the kinesthetic senses to be activated in a normal way rather than in an induced serialization, as occurs when the maneuver is done by the therapist alone. There should be definite relaxation of the adductors with the extremity in full flexion (fig. 9) with this reflex, after which the knee should be rotated back toward the vertical plane by the therapist, and the toes released (fig. 10).

With the toes released and with the flexed lower extremity now in almost a vertical plane position, a slight thrust downward on the knee over the belly of the quadriceps, a tap on the patellar tendon or a slight tap on the muscle with the palm will bring the leg back to its original position (fig. 11).

This exercise can be repeated very rapidly, with the result that when the physical therapist becomes skilled in the timing of the movement there will be a quick grasping of the foot, passive flexion of the toes, quick reflex

Fig. 5. — If the therapist uses this method of holding the part, the stretch reflex and the spasticity will be difficult to overcome, since the method does not take advantage of the reflex mechanisms which will aid both the patient and the therapist.

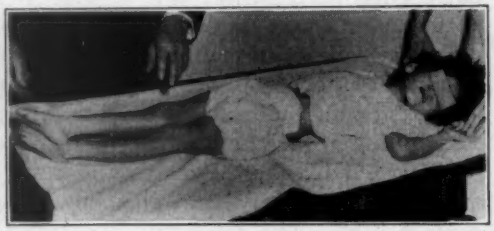

Fig. 6. — Cerebral palsy, with spastic diplegia and scissors type posture.

Fig. 7. — To utilize fully the spinal reflex mechanism for muscular and kinesthetic exercises, the toes are flexed downward quickly and the knee rotated outward slightly.

Fig. 8. — The spontaneous reflex produced by flexion of the toes carries the knees outward with full flexion of the leg upon the hip and relaxation of the adductors.

flexion of the leg at all its joints and rapid rotation from the outward relaxed position of the adductors to the vertical plane and downward to the original position. It will be seen at once that this exercise simulates an exaggerated pattern of walking as often noted in "steppage gait" and, if the patient were in the upright position, a real possibility of progression.

If this reflex of defense, or spinal automatism, is maintained rhythmically for a period of fifteen minutes in each lower extremity and then a combined response initiated by flexion of the toes of both lower extremities, simultaneously a remarkable degree of muscle activity can be elicited and a highly complicated pattern type of movement developed that will frequently take the place of the simple, almost stereotyped, spontaneous reactions of defense. After such exercise, the patient may be relieved for long periods of time from the painful jerking spasms of the legs, so frequently seen, especially in spinal paraplegia.

If these movements and reactions are observed while the patient is lying on the abdomen, it will be seen that the movements are similar to those initiated by the normal child in attempting to crawl. There is the tendency to draw the leg up and to flex the knee on the side with the toes bent downward, contacting the floor, the hips usually assuming the position of crawling.

It is important to note that if the toes are turned down when the patient is lying on the back and in the usual position of treatment the sole is rotated inward, as noted in figure 7. It is at this time that release of the spasm and the spasticity of the adductors are greatest. If the foot is maintained in its usually accepted position (fig. 5) and the knee and leg flexion are attempted in the vertical plane, not only is the spasticity of all of the muscle groups maintained in the extensor position but it is difficult to break this spasticity except by the clasp-knife method.

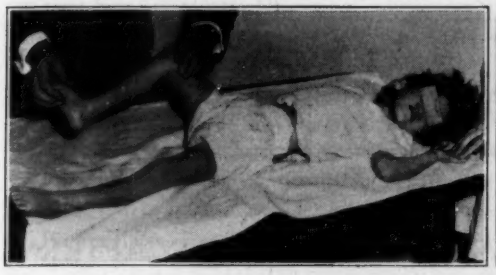

Fig. 9. — With the extremity in full flexion at the height of the reaction of defense, the toes are released and the knee is brought toward the midline by a rotary movement, in order to straighten the extremity and favor its position in a more nearly vertical plane.

Fig. 10. — The foot and leg are released and the knee or quadriceps group pushed downward to complete the cycle, or the quadriceps muscle may be stimulated or the tendon tapped to bring about the return of the leg by an extensor movement similar to that seen in the normal patellar tendon reflex action.

Aside from the fact that the utilization of the reaction of defense is a great saving to the physical therapist in effort and in time, there is, of course, the highly desirable effect of developing better kinesthetic muscle and joint responses from the various stretch and muscle contractions and

Fig 11. — Return to the relaxed position at the end of the reflex cycle.

coordinating mechanisms, so that a serialized and highly desirable pattern movement may eventually be obtained.

The patient's position is another point of extreme importance. If he is treated while lying flat upon the back (as is the usual custom), there will be found an increase of tone in all the extensor groups that are being treated when attempts are made to produce flexion. If, however, the patient is simply turned over on the abdomen, an immediate reversal of tone effect (through the labyrinth) may be accomplished and a great deal of the former spasticity and increased muscle tone diminished with the result that further physical therapy exercises can be more easily carried out. In all probability, this is a part of the tonic neck-labyrinthine, or otolithic, reflex, and when combined together, forms part of a pattern movement of progression of amphibian type. Such movements are normally found in infants long before the motor cortex develops the control of movements required in walking or other skilled activities and represent reflex activities far down the evolutionary scale of

the nervous system, when ocular, vestibular, and neck segmental zones of activity controlled, regulated and coordinated the serialized responses of the trunk segments and movement progressed toward the caudal pole, as in the earthworm. Certain of these segments eventually gave rise to the limb buds and the extremities. These extremities, or special additions to the trunk (seen in the transformation of the polywog to the frog), partake in a pattern movement beneficial to progression, but not entirely under cortical domination. These reflexes are present but latent as manifestations of spinal automatism in man and may be utilized again in spastic paralysis at primitive levels of function to the benefit of the patient, and as an aid to rehabilitation, if properly augmented and trained.

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A HYPOTHESIS TO EXPLAIN THE MUSCULAR AFTER EFFECTS OF POLIOMYELITIS *

MILAND E. KNAPP, M.D.

MINNEAPOLIS

The acute course of anterior poliomyelitis is of short duration. Its febrile manifestations rarely persist more than a week. Yet during that time irreparable damage may be inflicted upon the central nervous system with secondary effects upon the peripheral musculature which may never be overcome. At the present time there is no known method of prevention of the disease and there is no treatment which is effective in preventing or stopping the progress of the muscular paralysis. Therefore the treatment of the muscular residuals of poliomyelitis is still a mechanical problem which must be solved individually for each individual patient. The mechanical residuals which demand attention are of three types: muscle shortening, loss of muscular efficiency and muscle weakness. Muscle weakness may be further subdivided into weakness which is recoverable and that which is permanent. These changes are usually attributed to the results of damage or destruction of the large motor cells located in the anterior horns of the gray matter of the spinal cord which directly innervate the skeletal musculature. However, some of the muscular after-effects which have been described cannot be explained adequately by this simple pathologic concept. In this paper, I should like to present some ideas which, while purely hypothetical, may serve as a basis for future investigation to provide an explanation for these observed after-effects.

Internuncial Cell Hypothesis

I should like to present a hypothesis by which more of these facts may be explained than by any other theory with which I am acquainted. Kabat and I[1] in 1944 called attention to the fact that internuncial cells may be involved in poliomyelitis and that the condition of so-called muscle spasm is closely related to the condition which developed in dogs when the blood sup-

* Read at the Twenty-Fifth Annual Session of the American Congress of Physical Medicine, Minneapolis, Sept. 5, 1947.

1. Kabat, H., and Knapp, M. E.: The Mechanism of Muscle Spasm in Poliomyelitis, J. Pediat. 24: 123 (Feb.) 1944.

ply was cut off from the spinal cord for a sufficient length of time. In this condition anterior horn cells are not affected but the internuncial cells are extensively destroyed.[2]

The functions of the internuncial cells are not well known, but there are some facts which are known about them.

The internuncial cells are concerned with the transmission of impulses from cell to cell within the central nervous system. Conduction pathways from the cerebrum to the muscle usually include many such cells, but even the shortest pathway must include at least one internuncial neuron. They are the cells which connect the various sensory and motor elements in the spinal cord with each other and therefore are directly concerned with the correlation of motion. They are also the mediators of inhibition. As such, they control proprioceptive impulses relating to muscle tone and postural reflexes as well as coordination of muscle function. Lorente de Nó[3] stated: "Thus it comes about that the cerebellum as an organ is, from the point of view of elementary physiology, a giant chain of internuncial neurons, superimposed upon the reflex arcs in the spinal cord and the medulla." He has also discussed in detail the types of connections and the multiplicity of them both histologically and physiologically.

I will discuss each of the residuals of poliomyelitis individually.

Muscle Shortening. — The characteristic features of muscle shortening are the following: First, the shortening usually occurs very early in the course of the disease. It is often the first muscular symptom. We[1] have demonstrated that during this stage it is produced by a neurogenic mechanism which can be temporarily interrupted by spinal anesthesia. Thus, early in the disease it may be correctly designated as muscle spasm. However, there is one observation which is difficult to explain. This spasm may be present in muscles which have no voluntary function and which eventually become totally denervated. Occasionally the shortening may develop slowly over a period of a week or more, but this is unusual.

Second, in the later stages of the disease the neurogenic mechanism becomes less prominent and a peripheral factor becomes more prominent. During this stage, spinal anesthesia will not relax the shortening. It is probable that some type of fibrosis has occurred in the muscle which does not respond to anesthesia. At this time the muscle may or may not be painful to stretch but the lack of extensibility is still a prominent factor.

Third, there is no definite relationship between muscle shortening and muscular weakness. It may be present in a relatively strong muscle, in a relatively weak muscle or in the antagonist of either a strong or a weak muscle. In the past, muscle shortening has been ascribed to "muscle imbalance." By this concept it was thought that the shortening was due to the overpull of a relatively strong muscle against a relatively weak antagonist. The strong muscle would pull the part out of position, and adaptive shortening or contracture would occur, which would result in the deformity. It is my opinion that this concept needs a great deal of modification or it may need to be discarded completely. It is true that the situation is frequently encountered where a strong muscle is shortened in the presence of a weak antagonist if adequate treatment has not been given. However, I believe that this is due to the fact that the weak muscle cannot get rid of the shortening in its antagonist because it is not strong enough to pull it through its full range of motion against the force of the muscle shortening. If the strong muscle is stretched passively to its full length by adequate treatment, "muscle imbal-

2. Kabat, H., and Grennell, R. G.: Unpublished observations. Van Harrevald, A., and Marmont, G.: Course of Recovery of Spinal Cord from Asphyxia, J. Neurophysiol 2:101 (March) 1939.
3. Lorente de Nó, R.: Analysis of the Activity of the Chains of Internuncial Neurons, J. Neurophysiol. 1:207 (May) 1938.

ance" disappears, although the disparity in strength is unchanged. The concept of muscle imbalance is, in fact, illogical because there is no place in the body where opposing muscles are exactly balanced as to strength. The flexors are, in general, stronger than the extensors. The gastrocnemius-soleus group, for instance, is much stronger than the dorsiflexors of the ankle. For anything approaching "muscle imbalance" to occur, there must therefore be a disturbance in the coordinating or regulating mechanism in the central nervous system rather than just a differential destruction of anterior horn cells. That this may possibly occur, I shall try to show later.

Fourth, the frequently made statement that the neck, back and hamstring rigidity which is almost constantly present in poliomyelitis is a result of the meningitis associated with the disease and is proportional to the number of cells found in the spinal fluid has not been true in my cases. Some of the severest tightness has been present in cases with zero cell counts, and some of the highest cell counts were found in cases with minimal tightness. Thus it seems improbable that "meningeal irritation" is a major factor, at least in those cases in which tightness persists. There are a great many cases in which the neck, back and hamstring rigidity subsides rather quickly, and in these cases it is possible that meningeal irritation may be a major factor. The statistical study of the spinal fluid cell counts in relation to muscle tightness has not been completed and, consequently, exact figures are not yet available.

Thus the clinical facts about muscle shortening may be summarized as follows:

1. It begins within the first few hours after onset of the symptomatic phase of the disease.
2. It is neurogenic in the early stages.
3. It sometimes increases with the progress of the disease.
4. It persists long after the febrile stage of the disease has passed.
5. If muscle shortening is allowed to persist, the neurogenic mechanism decreases in importance and a peripheral mechanism (probably fibrosis) increases in importance so that in the late stages the shortening may be completely independent of the nerve supply.
6. There is no definite relationship between muscle shortening and muscle strength in either the same muscle or its antagonist.
7. Muscle shortening may be present in totally denervated muscles.
8. Motion involving the stretching of the muscles to their normal range of extensibility is an essential part of the treatment.

It is quite obvious that these conditions cannot be explained by considering only the involvement of anterior horn cells and that they cannot be explained by "muscle imbalance" alone.

Explanation by the Internuncial Cell Hypothesis. — If the normal cell relationship includes a situation in which the upper motor neuron connects with a lower motor neuron by several internuncial cells arranged in parallel, muscle spasm in a muscle which exhibits voluntary motor power might be explained by destruction of part, but not all, of the internuncial cells. Thus voluntary motion could be obtained through the intact cells while upper motor neuron inhibition could be lessened because of the destruction of a portion of the conducting intermediate neurons. Direct inhibition is a proved fact, but the mechanism is not known.[4] If certain cells are involved in inhibition, their destruction would explain the spasm.

The mechanism producing muscle spasm is illustrated diagramatically, in chart 1.

4. Lloyd, D. P. C.: Functional Organization of the Spinal Cord, Physiol. Rev. 24:1 (Jan.) 1944.

Muscle spasm in the complete absence of voluntary motion might be explained in the following manner. It has been demonstrated by Lloyd[5] that in the cat there may be a two neuron proprioceptive reflex arc, the sensory endings of which arise in a muscle and the motor endings terminate in the

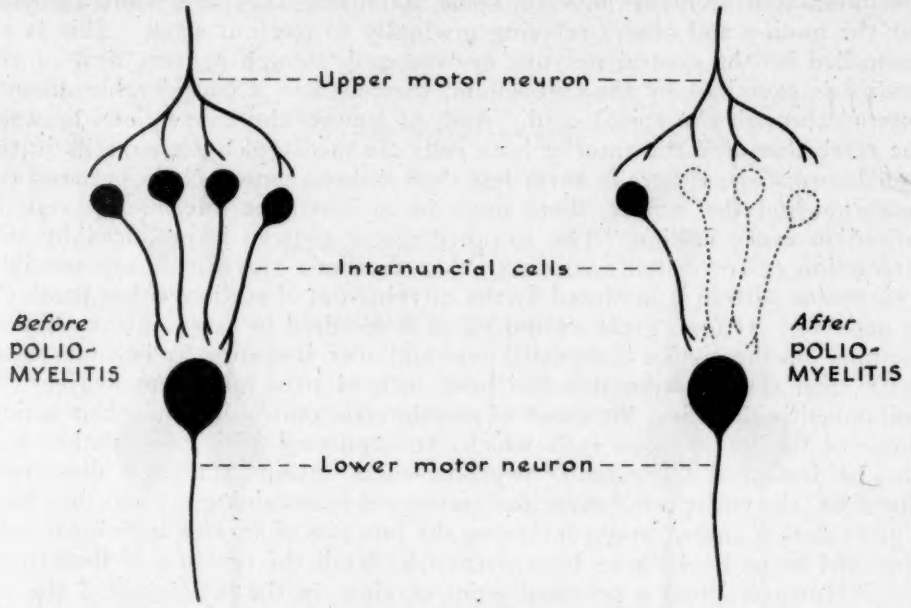

Chart 1. — Muscle spasm in the presence of motor power.

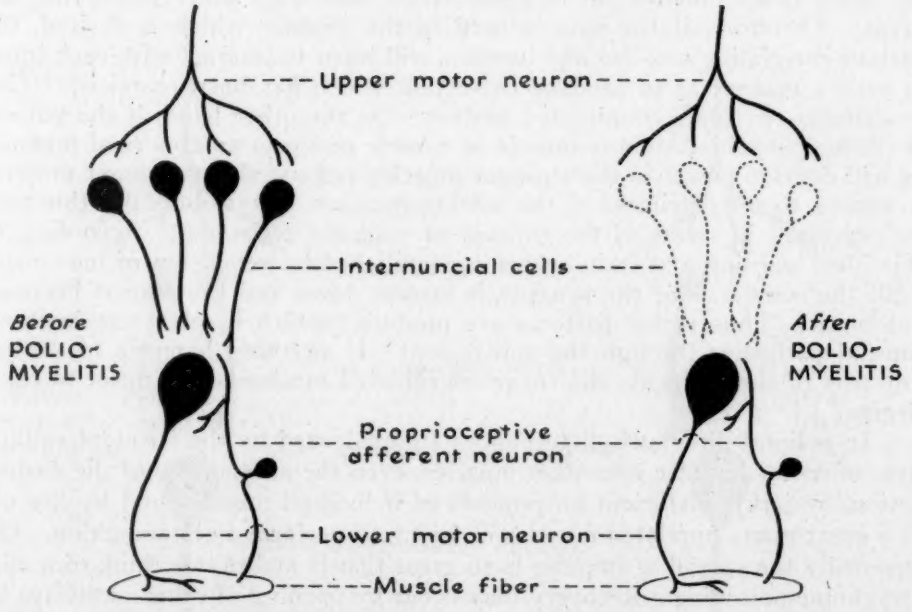

Chart 2. — Muscle spasm in the absence of motor power.

same muscle. Thus, if such a mechanism is present in man, it is possible that all the internuncial neurons could be destroyed and there would still be a source of impulse for the production of muscle spasm (chart 2).

5. Lloyd, D. P. C.: Neuron Patterns Controlling Transmission of Ipsilateral Hind Limb Reflexes in Cat, J. Neurophysiol. 6:293 (July) 1943.

Muscular Efficiency. — The factor of muscular efficiency or coordination in my opinion is extremely important in poliomyelitis, even more important than the development of muscle strength in providing functional ability for the patient. Coordinated, rhythmic, muscular movements are produced by the interaction of many muscles, some stabilizing the part, some carrying out the motion and others relaxing gradually to pay out slack. This is all controlled by the central nervous system, and, though a great deal of the control is exercised by the cerebellum, there is also a considerable amount exerted through the spinal cord. And, of course, the connections between the cerebellum and the anterior horn cells are mediated by other cells in the spinal cord. Since there is never less than a three neuron chain between the cerebrum and the muscle, there must be at least one internuncial cell involved in every motion. The so-called motor pattern is produced by this interaction of correlated neurons so that rhythmic movements are possible. This motor pattern is produced by the carrying out of motion, either passively or actively. At first, great mental effort is required to carry out any skilled motion. As the motion is repeated over and over, it eventually becomes automatic, and then coordination has been secured to a maximum degree. In poliomyelitis there is a knockout of certain cells controlling muscular action. Some of the internuncial cells which are connected with coordination may also be destroyed. The entire neuromuscular set-up has been disturbed; therefore, the entire neuromuscular set-up needs retraining. There has been a great deal of controversy concerning the function of various individual muscles, and many books have been written to detail the function of these muscles. However, from a practical point of view, in the retraining of the patient, it is necessary only to carry out the motions as desired. Muscles do not work independently but in combination with each other in varying degrees. Therefore, if the part is used in the manner which is desired, the various correlating muscles and neurons will learn to interact with each other in such a manner as to produce the action which has been practiced. This constitutes rhythmic coordinated motion. On the other hand, if the patient is allowed to substitute any muscle or muscle group in an abnormal manner, he will develop power in the stronger muscles and use these stronger muscles to excess, to the detriment of the weaker muscles. Physiologically this may be expressed in terms of the concept of synaptic resistance. According to this idea, learning and training are accomplished by repetition of movement until the resistance at the synapse is broken down and the motion becomes automatic. Thus motor patterns are produced which involve certain internuncial pathways through the spinal cord. If anything happens to disturb any part of the pathway, the entire coordinated mechanism is upset to some degree.

In poliomyelitis such disturbances are evidenced by the frequent spilling over of motor impulse into other muscles, even the antagonists of the desired action, by jerky, inefficient movements of individual muscles and by the use of a great many unrelated muscles in trying to perform a certain action. Occasionally the spread of impulse is so great that it makes one think of a mild strychnine poisoning. Recovery may occur by opening of other pathways by repetitive action breaking down the synaptic resistance. This is accomplished by muscle reeducation. This condition may also be explained by the internuncial hypothesis. A situation may be assumed in which one upper motor neuron sends impulses to two antagonistic lower motor neurons by way of internuncial cells. If the desired pathway is interrupted by destruction of the intermediate neuron, the impulse may then proceed to the antagonist, because that is the only pathway remaining (chart 3).

Muscle Weakness. — The muscle weakness which occurs in poliomyelitis may be divided into two types: (1) recoverable, or reversible, paralysis, and (2) permanent, or irreversible, paralysis.

Reversible Paralysis: Again, the reversible paralysis may be subdivided into that which recovers function spontaneously and that which recovers only

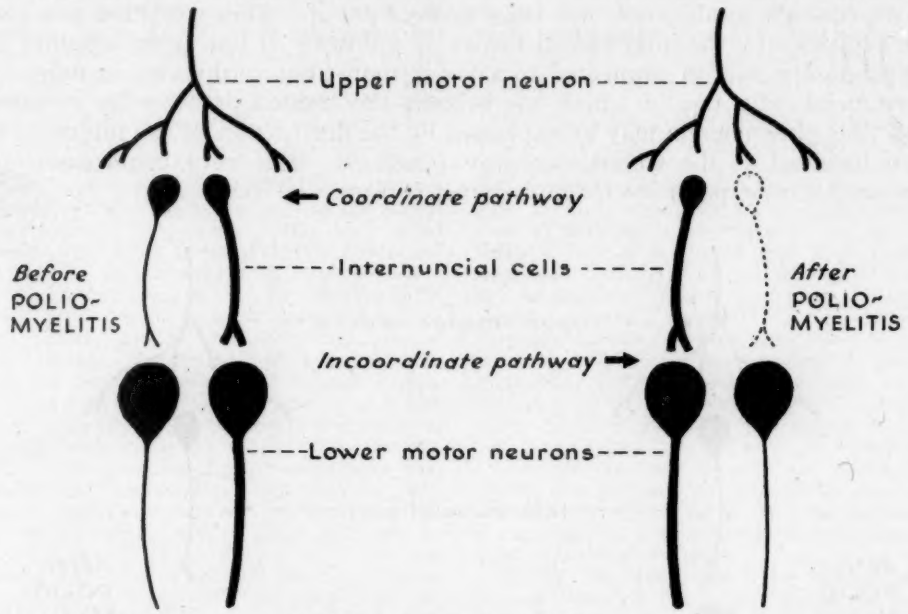

Chart 3. — Muscular incoordination.

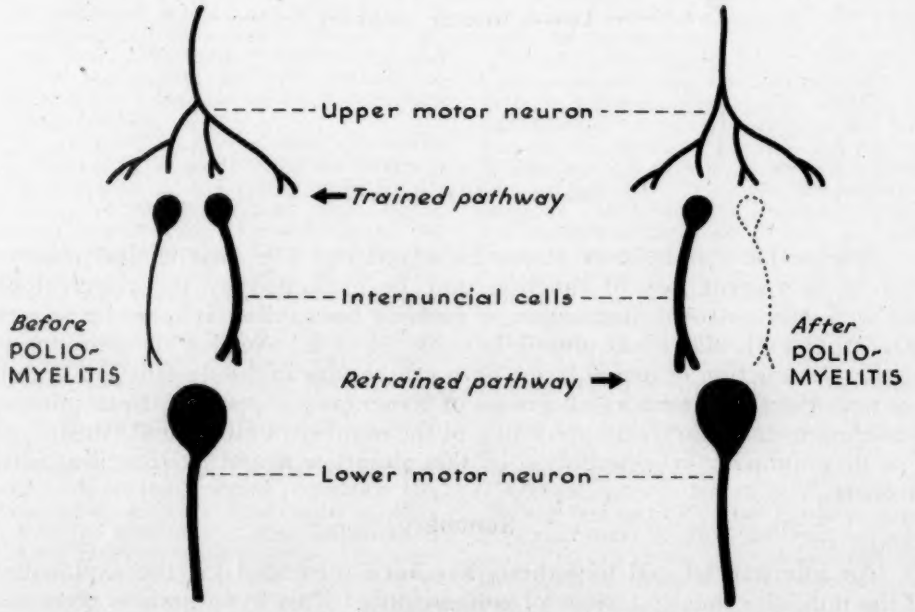

Chart 4. Reversible paralysis.

after training. Spontaneous recovery is usually explained by assuming that loss of function is due to inflammatory conditions involving the nerve cell which subside following the acute disease process. Such factors may be

invasion of the cell by the virus, edema formation in the neighborhood of the cell, circulatory disturbances, lack of oxygen supply, etc. These processes require no further explanation. However, it can be demonstrated that some muscles may not recover function for years unless measures of reeducation are used. And recovery may be accomplished at a late date by reeducation. This has been designated as "mental alienation" in the Kenny concept, and a psychologic explanation has been evolved for it. This condition can also be explained by the internuncial theory as follows: If one again assumes an upper motor neuron connected to a lower motor neuron by two or more internuncial cells, one of which has become the trained pathway by constant use, this phenomenon may be explained by the destruction of the internuncial cell involved in the trained pathway (chart 4). Recovery could occur by training a new pathway through intact internuncial cells.

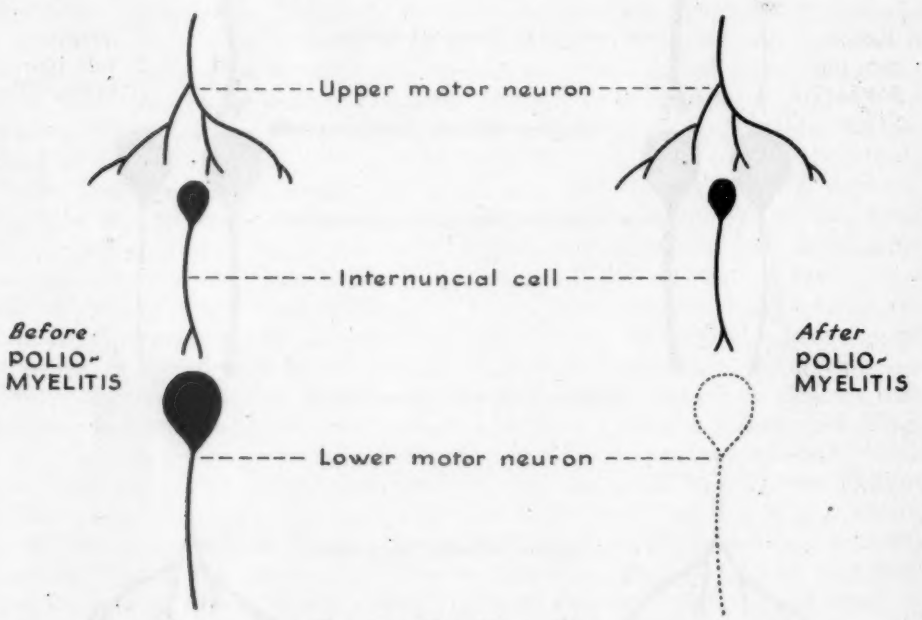

Chart 5. — Motor denervation.

Irreversible Paralysis or Motor Denervation: The final clinical observation of permanent loss of function may be explained by the conventional and well demonstrated destruction of anterior horn cells. It must be remembered that each individual muscle is made up of a collection of many motor units. Destruction of one anterior horn cell results in the destruction of only one motor unit. Therefore all grades of weakness are possible, from minimal weakness to total paralysis, according to the number of motor units destroyed. The diagrammatic representation of this situation would be that illustrated in chart 5.

Summary

An internuncial cell hypothesis has been presented for the explanation of the muscular manifestations of poliomyelitis. This hypothesis is presented purely as a working basis for the investigation of these manifestations. I do not claim that this is the correct explanation for those symptoms, but it does represent a change from the accepted manner of thought about the disease and therefore it may help to bring about some advances in the management of poliomyelitis.

Discussions of Papers by Drs. Knapp, Van Riper, Kubicek, Gellhorn, Kottke, et al. and Huddleston and Golseth *

Dr. E. J. Huenekens (Minneapolis): Let me congratulate your society on this comprehensive, up-to-the-minute symposium on poliomyelitis — comprehensive except for two aspects of the disease which I will take up later. Dr. Kottke's interesting but limited studies tend to show that curare and hot foments failed to produce clearcut beneficial effects or aids to muscle stretching and raise the question of their value in the treatment of acute poliomyelitis.

As chairman of the polio emergency committee during the 1946 Minnesota epidemic but with no active part in the actual treatment of the cases, I was in a good position to judge objectively the value and results of the treatment of approximately 2,000 patients cared for in Minneapolis. The great bulk of them were treated by hot packs, muscle stretching and muscle reeducation. These methods are time consuming and expensive and require highly trained technicians to carry them out; but they have cut down the deformities due to muscle shortening to a minimum, though, of course, not affecting the cases with true paralysis. Any method that will simplify these procedures and still produce as good or better results will be most welcome to everybody who has to care for these patients, and studies such as Dr. Kottke has made are very valuable and should be encouraged. However, until short cuts such as the elimination of the hot foments are definitely proved to be sound or until we have perfected better procedures, it is my opinion that, from a purely clinical viewpoint, hot packs, muscle stretching and muscle reeducation are the methods of choice in the treatment of the spinal form of poliomyelitis.

Just a word about the technicians who carry out the treatment under the direction of physicians. In last year's epidemic, the majority of our technicians were highly trained, conscientious men and women, but a small proportion had been inadequately prepared. As I see it, one of the most difficult jobs ahead of our nation is to train thoroughly enough technicians to handle our polio epidemics and at the same time to guarantee them adequate employment between epidemics. Finding the right answer to that problem is a study which might be undertaken by your society with profit.

When it comes to the bulbar form of polio, where the greatest mortality lies, these same methods have little to offer. It is in the treatment of these bulbar cases that the research work done the past year, and still going on at the University of Minnesota, brings rich fruits. The classification of the different forms of bulbar polio, the value of oximetry, the selection of the type of case that can be benefited by the properly timed use of the respirator and/or tracheotomy, all give us hope of cutting down the high mortality found among the bulbar types of polio. This new understanding of the mechanism of bulbar polio and the resulting better treatment saved many lives last year, and probably would have saved more if all the facts had been available at the beginning of the epidemic.

Finally, a word about the two aspects of polio which were not considered in this symposium. They were not in the program because the answers to them are not available at the present time. The first unanswered problem is the epidemiology of the disease, how it is spread and what measures will control that spread; why there are so many grades of immunity, ranging from complete freedom from attack through various types of light cases to the severest. We have no answers to these questions, and that lack causes the most serious gap in our knowledge of the disease. Of almost equal importance is the second missing item in your symposium: a specific vaccine, serum, or antibiotic which can protect our population against the disease or, if contracted, can produce a cure without our present prolonged and cumbersome procedures.

Dr. W. H. Northway (San Francisco): It is a pleasure, but a bit difficult, to discuss a paper in which the discussant agrees so completely with the author. When one finds oneself in such a situation, one solution is to reemphasize the points made by the author.

Muscle shortening has been particularly well presented, and its characteristics in time of appearance, site and possible explanations for its appearance have been adequately discussed, as has also the method of treating this very common and harmful clinical finding. It cannot be repeated, however, too frequently that early gentle motion within the limits of pain and later forced motion intelligently carried out so that the forced motion results in a continuous increase in joint range is the most important therapeutic procedure in the treatment of muscle shortening. Hot packs, as the author emphasizes, may be of assistance and a comfort to the patient when pain is a major complaint. The packs should be very hot and very dry, and the patient may object momentarily when they are first applied.

Adequate muscle length to allow for the efficient functioning of the opposing muscle group must be obtained, and this adequate length must be maintained by stretching exercises over an indefinite period of time.

Muscle weakness can be treated only by active exercise, and the exercise prescribed must be supervised carefully to be sure that the weak muscle is the muscle getting

* The papers by Drs. Gellhorn and Huddleston and Golseth were published in the February, 1948, issue of the ARCHIVES; that by Dr. Kottke, et al, in the March issue, and those by Drs. Van Riper and Kubicek, in the April issue.

the exercise. Muscles to gain strength must contract against a maximum load, but, as the author has pointed out, frequently the weight of gravity of the limb is more than the maximum load for the weak muscle and no further resistance is necessary.

The author's emphasis on the importance of muscular efficiency and how to obtain it is clear, simple and sensible and should be the goal toward which all therapists should strive.

Dr. G. J. P. Barger (Washington, D. C.): Ultraviolet blood irradiation may possibly contribute something in the treatment of poliomyelitis, in view of the following, in the Medical Annals of the District of Columbia, by the Children's Hospital Committee on Poliomyelitis, of the 1944 poliomyelitis epidemic:

"At the height of the epidemic we were getting a great many bulbar cases of a severe type, many were very severe, even moribund. Of the first 114 patients with bulbar involvement admitted, 5 died. Four of these patients died within 24 hours after admission; 2 were put into respirators and showed aspiration of secretion at autopsy. They had been ill 5 to 10 days before admission. The 5th death occurred after 3 days of treatment.

"It was at this time that ultraviolet irradiation of blood was started with the help of Dr. G. J. P. Barger of the Georgetown Hospital. It was used on 11 bulbar cases, 1 death occurring in this group.

"Thirteen patients with bulbar involvement were later admitted, none of which received blood irradiation, and there were no deaths. Three of them had pontine involvement rather than bulbar. This observation is made because many of us felt that ultraviolet irradiation seemed to combat the toxicity of many of the cases, although in bulbar cases there are often sudden changes. It was felt that in toxic bulbar cases, especially those with encephalitic signs, the use of ultraviolet irradiated blood deserves consideration and further trial. We feel fairly certain, however, that the early use of ultraviolet irradiation does not influence the development of spinal paralysis."

A more detailed but unpublished report of this epidemic shows that in the 14 cases not treated by blood irradiation there was one whose swallowing reflex returned in twenty-four hours; all the others required four to fourteen days before recovery, whereas among the 11 cases treated by irradiation of blood, in every instance the swallowing reflex was obviously recovering in twenty-four to forty-eight hours, which gave the child a likelier chance to live and greatly reduced the work in his care.

"No harmful effects were noted in the UBI treated group, and in fact all seemed to benefit. It seems to give patients a feeling of well-being. It reduces toxicity."

The observations on the Washington bulbar polio cases treated by irradiation of the blood showed almost identical results with those reported by Miley and published in ARCHIVES OF PHYSICAL THERAPY in November, 1944.

Dr. Jessie Wright (Pittsburgh): We have treated 14 patients with Intocostrin and stretching. We have found the optimum point of relaxation twenty to twenty-five minutes after the intramuscular injection. I wonder whether giving the intramuscular injections, as the authors have done, twice a day instead of three times a day does not make some difference in the result.

In 3 of our patients, on account of change in nursing personnel and other professional staff, we gave two doses a day for three days instead of three doses, and we found that a tendency toward shortening occurred, which relaxed again after resumption of the intramuscular injections every eight hours.

I think that it is very important not to overstretch the irritable muscles. The stretching should be done carefully and should not be followed by additional shortening or residual soreness, which could and does occur if the stretching is carried out too strenuously.

I enjoyed Dr. Knapp's paper. He always gives us something new to think about. All the papers by the investigators from the University of Minnesota are opening a new field of thought for those of us who are interested in poliomyelitis. Dr. Huddleston's electromyograph pictures give an insight into analysis of fibrillation and spasm under various conditions in the poliomyelitis patient.

Dr. A. B. Baker (Minneapolis): One must keep in mind, in using curare, that any drug used in a bulbar poliomyelitis patient is dangerous. Even small amounts of sedative in a patient with bulbar poliomyelitis may make the difference between a live and a dead patient. The same is true for curare. We have lost patients when we were using curare primarily because the bulbar involvement developed during the time that curare was being given.

I believe that in any patient who has or might develop bulbar symptoms one should be very cautious about the use of curare or any other drugs. I am not speaking for or against curare — I am speaking against the use of these drugs in patients with bulbar poliomyelitis.

Dr. O. Leonard Huddleston (Los Angeles): I would like to add a few comments about our experience with "polio" at the Los Angeles County General Hospital.

Toward the latter part of the epidemic last year we began using intratracheotomy and the use of oxygen and helium mixture for treating a number of these respirator cases, and we found that this procedure did facilitate the treatment of respirator cases and confirmed what has been said previously about this method of treatment.

We found also that some of these cases could be better managed in the early stages of respirator therapy by giving curare. This procedure may not sound too logical to many people, but to those who have had extensive experience in the use of artificial respirators it is common knowledge that

some patients who do not have complete respiratory paralysis but need a certain amount of assistance when first put in the respirator may be very apprehensive, struggle and fight the respirator. Such patients are given enough curare to minimize the resistance to the respirator; from then on the respiratory movements are adjusted to the rhythm of the respirator and the patient is much more comfortable and better adjusted to the machine.

With regard to another phase of treatment concerning the use of curare, we made observations on some fifty patients in the acute stage beginning soon after the onset. The most severely involved patients were selected for observation. We were not particularly interested at that time in how much the range of motion could be increased and how much it affected the tightness of muscles or influenced the extent of muscle stretching. We were more interested in learning something about the effects of curare on "polio" patients, how safe it was, how dangerous it was and lastly, did it offer any promise as an improved method of treating "polio."

One of the things we observed was that in a number of these patients who had rather marked opisthotonos and a rather severe amount of pain and apprehension they were much more comfortable after the injection of curare and many of them were able to sleep well at night, whereas they had been unable to do so before; curare did seem to be very beneficial in treating some of these patients. In several instances at least it gave them much more relief than we were able to get by using packs.

Our impressions about some of these cases were that if we were going to get any beneficial or satisfactory results from the use of curare in increasing the relaxation, increasing comfort of the patient, it would be obtained early, from the second to the sixth day. Continuing the treatment beyond that did not seem to have a great deal of effect.

With regard to the use of curare in the treatment of "polio" cases in the respirator I may say that we did not observe any harmful effects from its use and that we gained enough experience to convince ourselves that it was a beneficial adjunct in the treatment of such cases. Furthermore we may say without hesitation that it can be used under such circumstances without great apprehension regarding the dangers of its use.

Dr. Ernst Gellhorn (Minneapolis): I would like to ask a question of Dr. Huddleston. What is your complex motor response? Does it occur in normal individuals? What are the respective conditions under which you get them, and what are the characteristics?

Dr. O. Leonard Huddleston (Los Angeles): Replying to Dr. Gellhorn's first question, we consider complex motor unit voltages as waves having four or more alternations; monophasic, diphasic and triphasic waves are classified as simple motor unit voltages. In reply to the second question, it has been our experience that complex motor unit voltages are abnormal electromyographic phenomena and therefore are not encountered in a normal neuromuscular system. Replying to question number three, complex motor unit voltages are associated with lesions of the lower motor neuron system. In peripheral nerve injuries, for example, they are found as a rule at the time of neurotization; their presence may be interpreted as one of the early signs of nerve regeneration. They persist throughout the period of recovery, and progressively decrease in number during the progress of nerve regeneration. With polio, we find complex waves occurring in the early stage of the disease, i. e., between the 21st and the 90th post-onset days. The early appearance of these abnormal waves makes it appear likely that they are associated with the process of neural degeneration rather than with regeneration.

With regard to the last question, the characteristics of complex motor unit voltages are as follows, they are polyphasic waves of four or more phases which range in magnitude from 20 to 1200 microvolts, having a repetition frequency of from 2 to 30 per second, and a duration of from 5 to 15 milliseconds. When heard via the loud speaker, they may be recognized as harsh, low-pitched noises. The sound characteristics of these waves differ quite materially from fibrillation voltages and from normal motor unit voltages. As a general rule, one may identify the different types of electrical activity by their characteristic sound qualities. With sufficient experience in electromyography, the normal and abnormal electrical activity encountered in "polio" muscles can be differentiated merely by their sound qualities. It is generally desirable, however, to measure their characteristics accurately, and to do this it is necessary either to view the magnitude and wave form on the oscilloscope or record them photographically as electromyograms.

Dr. Louis B. Newman (Chicago): I would like to ask Dr. Huddleston a question or two. I didn't quite understand the technic.

In getting further tracings do you place the needle electrode in the same position, or do you attempt to place it in the position where you get the maximum amplitude for the fibrillation going on?

Also, does the depth of the point of the needle alter the tracing — the depth to which the needle is placed in the muscle?

Also, what material do you use for the needle, and is the needle partly insulated as it goes through the skin and subcutaneous tissue?

Dr. O. Leonard Huddleston (closing): Answering your last question first, the needle is a plain steel needle which is coated, except for the very tip, with vinylite, therefore it is completely insulated except at the tip.

The other electrode is a small foil about 3/4 inch square. In sampling the muscle the needle is inserted through the skin and into the superficial layer of muscles; the

wave formed is sampled at that area, and usually at that depth is run out into several different areas at that level; that is, up, down to the side and maybe to two or three other directions if indicated.

Then the needle is inserted to another deeper area and again explored in the different directions at that level. Then the needle goes on down to a still deeper level, until the full length of the needle is reached. That is the way a muscle is sampled at one area.

The areas which we explore for reexamination, as stated, usually are the proximal and distal portions of the muscle in as nearly the same areas as possible. We do not make any attempt to examine the exact point area for the insertion of the needle at successive examinations. One way we get away from that, of course, is to sample it at different levels or different directions, at one level in an area.

The only place we get those electrical currents is at the tip of the needle electrode, and it comes from no place else; so we are sampling individual muscle fibers for motor unit responses.

Dr. Kottke (closing): Dr. Wright's point is a good one. In all fairness to any treatment, one must evaluate it on the basis of what has been done. Our treatment did vary from what Dr. Ransohoff and Dr. Wright have done.

We used the curare only twice a day, with stretching immediately afterward. As I understand Dr. Ransohoff's treatment, he gives one dose of curare at midnight with no stretching following it. Our presumption has been that the great beneficial effect in the early treatment is the stretching involved, and, conseqeuntly, we saw little reason for giving the curare at midnight if no stretching followed.

I realize that the question of stretching is quite important. The attitude in the past has been that one must be very careful of the involved muscle in polio, that any time one puts it on stretch one might injure it. It has not been our experience that we damage muscles by stretching. The streching we do is very vigorous, past the point of pain. It doesn't go quite so far as Dr. Ransohoff says he goes with his patients, but our criterion is this: If the patient becomes tender after stretching, if he has residual pain, then we decrease stretching slightly. We say within the range where there is pain on stretching but there is no pain after stretching, and in that range we have found no detrimental effects from the stretching itself.

I should like to emphasize at this time Dr. Huenekens' point. We have made no attempt to evaluate the effect of either hot packs or curare on the pain of acute polio; consequently our paper has no relation to that.

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CORRECTIVE PHYSICAL REHABILITATION FOR NEUROPSYCHIATRIC PATIENTS *

JOHN EISELE DAVIS, Sc.D.

Chief, Corrective Physical Rehabilitation,

Medical Rehabilitation, Veterans Administration

WASHINGTON, D. C.

The fundamental need of the mentally sick patient for constructive and acceptable physical expression has been long recognized by psychiatry and the related medical sciences. Dr. Abraham Myerson[1] affirms: "Physical treatment remains the basic treatment in psychiatry on the well known formula, 'bens san a in corpore sano'." Dr. Edward Strecker[1] explains: "In certain of the psychoses and perhaps especially in schizophrenia there exists a very definite need for physical activation, since the tendency to lapse into an inactive and lowered functional state is quite prominent."

For the psychoneurotic type of patient, Myerson[1] states that "the effects of physical activity on anxiety is very striking, and I make it a cardinal part of my treatment of the patients who have anxiety."

The present program of corrective therapy in the Veterans Administration has followed a trend of the armed services, in which, as Rusk[2] has stated, "Exercises 'by the numbers' as given in mass calisthenics during the soldiers' early military training are now replaced by personalized prescribed activity and reconditioning procedures." Corrective therapy operates as a companion therapy to physical therapy and occupational therapy as part of a triad of physical medicine and provides medically prescribed, individualized exercises. In the field of mental therapeutics, the social aims become the major psychologic consideration and the program of corrective exercise therefore includes a wide diversity of activities related to the personality, as well as physical needs, of the patient.

Basic Viewpoint of Activities in Psychiatric Treatment

The basic concept of activities in psychiatric treatment was brought out during the recent course of psychiatric orientation for corrective physical rehabilitation personnel conducted by Dr. Karl Menninger. An instructor, in attempting to promote self direction in games, requested alert schizophrenic patients to choose up sides. He observed that the patients did not always select the best players but would choose their friends. The idea naturally evolving in this psychiatric situation was not necessarily to win but to promote the friendly, cooperative aspects over the purely competitive. This simple episode illustrates in a striking manner the basic emotional need of an activity program for the mentally sick and demonstrates the fact, borne out by experience, that the aims of exercise must be primarily psychologic if they are to meet the fundamental needs of the participants. As still another illustration of the basic psychosomatic situation, attention is called to neurotic patients who come to the physiatrist with a pain in the arm as the result of a functional condition. The patient may be carrying out a desire to become ill, and the physiatrist is careful to avoid reinforcing this innate wish and thereby

* Read at the Twenty-Fifth Annual Session of the American Congress of Physical Medicine, Minneapolis, Sept. 3, 1947.

1. Personal communication to the author.
2. Rusk, Howard A., and Voldeng, Karl E.: Physical Medicine in the Army Air Forces Convalescent Hospital, Arch. Phys. Med. 30:766, 1945.

implementing the illness by treating the so-called affected part. Physiatrists have recorded experiences in such cases in which they have avoided physical treatment in favor of a psychologic approach to the conflictual situation. Such experiences are laying the foundation for a closer liaison between the physiatrist, the psychiatrist and the psychologist, and the corrective therapy activities to be effective in this relationship must be prescribed with an understanding of these diverse yet interdependent factors.

A concept of exercise as a part of physical medicine for mental patients emphasizes the emotional factors and their relationship to dynamic rehabilitation. The psychiatric application of activities has been explained by Adolf Meyer[3] as follows: "The best form of treatment is the removal of the cause. The best readjustment is the use of the parts which work so well to give the most normal setting for what needs readjustment." As a means of indirect therapy, a form of emotional readjustment through a wide and scientific gamut of activities, the corrective program of the Veterans Administration is expanding its area of usefulness.

It should not be inferred, however, that the complete corrective exercise program of the Veterans Administration is contained in this concept of psychologic objectives. The types of activities specifically provided include corrective exercises individually prescribed and administered; reconditioning exercises to increase strength and endurance, as exercises for the shoulder girdle in the reeducation of the paraplegic patient, and postural exercises for regressed schizophrenic patients. Exercises and activities adapted to meet the therapeutic needs of various disease entities are, for example, socially stimulative exercises for the depressed involutional melancholic patient, stabilizing exercises for the hyperactive manic-depressive patient. Specialized exercises are also prescribed for the various types, including quieting, relaxative and sedative types of activity, such as swimming and calisthentics with music.

Exercises as an adjunct to the total psychotherapeutic methods employed may be prescribed for the following differentiated psychiatric conditions[4]: (*a*) transient personality reactions to acute or special stress, (*b*) psychoneurotic disorders, (*c*) character and behavior disorders, (*d*) alcoholic intoxication and drug addiction, (*e*) disorders of intelligence, (*f*) psychoses without known organic etiology, (*g*) psychosis unclassified and (*h*) psychiatric conditions with demonstrable etiology or associated structural changes in the brain or both.

In transient personality reaction the patient has sustained "the normal results of an abnormal situation." The situational factor would be stressed for patients with these superficial maladjustments. Once the situation is changed, the patient is likely to improve. Therefore, exercises creating a more stable and infectious environment may be helpful. The psychiatrist will prescribe many types of exercises suited to the interest aptitude and physical tolerance level.

In the psychoneurotic groups, however, there is a deeper involvement, due to the repression of powerful emotional charges from consciousness. Since they are usually attached to infantile and early childhood developments, these emotional charges, through analytic methods, may be attracted to play experience. It is a well known fact that the psychoneurotic patient is able to find a distinctive release of anxiety tension through gross physical expression in play. Since heredity, constitutional and cultural factors are in-

3. Meyer, Adolf: Spontaneity, privately published booklet by Mental Hygiene Division of Illinois, Congress of Public Welfare, Chicago, October, 1933, p. 26.

4. Taken from "Nomenclature of Psychiatric Disorders and Reactions," Veterans Administration Technical Bulletin, TB 10A-78, Oct. 1, 1947. This nomenclature gives the modern concepts of psychiatric thinking and sets forth the character and behavior disorders as differentiated from the actual psychoneuroses, affording a most helpful and practical basis for the prescription and administration of exercise.

volved, the type of activity prescribed would depend upon family and community interests and acceptance as well as cultural pressures.

On the other hand, in the schizophrenic group reality is the crux of the therapeutic problem and exercises must be prescribed for the purpose of diverting self preoccupation into external interest. If exercises can aid in this direction, they will assist in the repression of conflicts precipitating breakdown and aid in a synthesis of the patient's personality. In selecting types of exercise, the schizoid characteristics should be taken into account in an intensive individualized prescription in which the patient's uniqueness provides a basis for initial and continued exercise. A comprehensive list of activities is necessary. The schizophrenic patient may benefit from soft ball and be rebuffed by baseball. He may be helped by miniature golf and become emotionally upset by the conventional game of golf. The premorbid personality will afford the basis for a determination of these activities, which should be reeducational in nature and emphasize advancement from individual to group interest in activities.

The prescription of exercise for this patient as of any other must, of course, fit into his complete diagnostic evaluation, which takes into account not only (*a*) the diagnosis (type and severity of symptoms) but (*b*) the external precipitating stress, (*c*) premorbid personality and predisposition and (*d*) estimated resultant incapacity. In addition, the corrective therapist in carrying out prescribed exercises must also give considerable weight to (*e*) inherent skills and (*f*) evocable interest and (g) learning capacity as shown in exercise situations. Fast exercises are more acceptable to the hyperactive state of the manic-depressive patient. Badminton, tennis, dancing and other such activities, allowing the patient freedom of movement and providing opportunities for changing of position and fast manipulation of movement, may be indicated as an initial exercise to be followed in such activities as volley ball, basketball, etc., when the patient improves in motor adaptation to the level in which he is able to accept group control as well as group stimulation. Inherent skills will often be a determining factor in these cases, enabling many distractable patients to concentrate attention upon activity. The general aim is to discharge excess energy into constructive social channels, create attitudes of confidence and good will and promote a feeling of well-being and release through expansive big muscle activity.

For many negativistic types of patients in various psychiatric categories, simple phylogenetic exercises provide the only available initial approach. Included are regressed, habit-training and catatonic patients. Exercise related to evolutionary developments, such as swimming, creeping, crawling, pushing, pulling, lifting, climbing and throwing, are effective. Some mute stuporous and negativistic catatonic patients are able to exercise by aid of pulley arrangements in which the return pull of the weight assists in sustaining participation in the prescribed activity. For this group, parts of games involving hitting the ball, for example, such as serving the volley ball and hitting the tether ball by hand or by racket, are effective. Climbing a few steps on steel bars may provide an initial exercise, while swimming will reactivate many negativistic patients. In these cases, Adolf Myer's maxim "simplify the situation" is pertinent. Activity should be reduced to its simplest components. Some far regressed patients are enabled to follow slow calisthenics exercise if they are presented in straight-line movements and are further simplified by a touch objective principle, in which the patient touches his foot, points on the floor, etc. Throwing and catching a ball provides an elemental phylogenetic exercise often suitable as an initial phase of activity therapy.

Socially stimulative exercises are applicable to all types of patients, especially to those with schizoid reaction cases. These exercises are best organized and presented as activities or experiences in which the patient may tend to advance from individual to group interest. A paranoid schizophrenic patient, while his persecutory sphere is apparently uninfluenced by a play activity (even though he is able to find much interest in it) will frequently expand his social interest through participation. Over a period of fifteen years I played table tennis with a catatonic patient. During this period he made the following readjustments: (1) improved in his play until he became a state champion; (2) advanced socially (whereas at the beginning he would play only with a selected few, he later began to play with other patients and finally with visitors); (3) gained egotistic satisfaction from these experiences; (4) agreed to teach others the fine points of the game, and (5) apparently was assisted in maintaining general physical health by this regular exercise. Although (6) his reactions tended to be generally rational when winning, he usually reverted to ideas of persecution when losing, but (7) these irrational ideas did not show any apparent change as a result of activity.

Ideally the therapist should inquire, "How does this prescribed exercise fit into the planned new controls for the patient?" Future developments in diagnostic procedures will make available these foundational factors so necessary to prescription of activity. Problems of fatigue may further complicate the prescription of exercise for the manic-depressive patient in the hyperactive phase. Readjustments are to be correlated with the psychotherapeutic methods employing and becoming a part of the over-all treatment.

CASE 1. — A man, age 38, had a severe manic-depression reaction in the depressive phase — suicidal, condition chronic. The external precipitating stress was loss of his father. There was a severe predisposition with previous attacks of depression. The degree of incapacity was marked, and he required hospitalization. The inherent skills were good, especially in ball games.

Patient, when a child, would often play ball with his father. While in the hospital, he took part in modified soft ball, later progressing into the full game. Physical reactivation made him feel better and placed him into more cooperative relationship with other treatments. It was necessary to change his position on the soft ball team from third base to second base to allow him more time to field the ball. When this change was made, he became more aggressive in the play situation, and later he requested to play hard ball. Improving in skill and the ability to play with others, he advanced from his ward team to an all-star team, continuing to build up feeling of personal worth and importance. These factors were considered supportive aids in his improved adjustment to the total psychotherapeutic activities in the hospital.

CASE 2. — The patient had chronic severe schizophrenia of catatonic type, the external precipitating stress for which had been inability to pass a college entrance examination. He manifested a strong predisposition, having been peculiar as a child. The degree of incapacitation was marked, necessitating hospitalization. He had been a good athlete, especially in baseball, but was apprehensive, confused and restless when a program of exercise was suggested. Elemental types of activity were first used, including handling and passing medicine balls. Basketball was then introduced, the patient bouncing the ball on the floor and kicking it. Over a period of four months he gradually developed an interest in shooting baskets, an activity in which he would voluntarily engage for hours at a time. He began to talk, saying that he had not played basketball in college because "they were crooked." He did not like to learn new games but would play on the hospital team. The development of skills in this activity seemed to stabilize the patient and assist him toward a more amenable attitude and effective cooperation with oral psychotherapy. Other apparent results were (*a*) group association, of the patient with the leader; (*b*) awakening of a spirit of rivalry, and (*c*) increased sense of importance and improved emotional habits.

CASE 3. — Expulsion from college for drunkenness had been the external precipitating and stressing factor in this patient's chronic severe schizophrenia of catatonic type. There had been a strong predisposition, and schizoid features had been manifested in childhood. The severe degree of incapacity necessitated hospitalization. The patient was actively hallucinated and antagonistic, but his inherent skills were good. He was a proficient athlete, played many sports and was unusually intelligent and well informed on those subjects. He used superior skill in games as a means of projecting his strong

egotistic feeling upon his fellow patients. He wanted not only to defeat but to humiliate and punish his opponents, who were considered as enemies. Over a period of six years, during which the patient progressed in a wide variety of activities, including championship honors in baseball, bowling, tennis and golf and was awarded a medal as the best all-around athlete, some of these arrogant ideas became replaced by more social desires and greater social understanding. Fellow players either ignored his egotistic reactions or suppressed them in the leveling processes of the game. It is believed that exercise in this case became a normalizing, objective experience of sufficient weight to attack successfully some of these irrational ideas and to create habit patterns of more normal behavior under the stimulation of play activity. Therapeutic aims in this case were (*a*) to increase the patient's happiness; (*b*) to improve his relationship with other people; (*c*) to increase his feeling of self respect; (*d*) to increase patient's maturity, and (*e*) to aid in the alleviation of symptoms through medical prescription of exercise skills and their integration into the total psychotherapy employed.

The physical medicine program in the Veterans Administration now includes the prescribing of individualized corrective exercise in the treatment of the acutely disturbed neuropsychiatric patient. After World War I, these types of patients were segregated in the designated acute services of the Veterans Administration neuropsychiatric hospitals and for some was prescribed general hydrotherapy, which was restricted mainly to packs and tubs for sedative effects. The patient himself in most instances became a negative recipient of treatment, making little, if any, personal contribution to it and showing no interest in such treatment.

Physical exercises of a noninteresting calisthentic order were given at times in the wards to confined patients, but the extroverting forms of sports and play were not provided. A large number of patients were thus treated, but only a few, after passing through these periods of hyperactivity, were permitted to participate with the volley ball or soft ball teams or engage in similar sport activities. Indeed, it was noted that in this small number there was no definite correlation between types of activity and its specific benefit for the patient's mental improvement. These activities were organized and carried out on a group diversional level, without recourse to the significant psychotherapeutic material which these play situations might awaken and which might be redirected into areas of social adjustment. In so far as exercise was concerned, it was the policy to wait until the patient had passed through the period of excitement. Some psychiatrists were cognizant of this situation and felt the need for planned activity at this crucial stage. But because of a shortage of adequately trained therapists during the recent war emergency period, generalized medical inertia and a prevailing lack of understanding of the possibilities inherent in this new concept, it was not possible to remedy this situation.

Since the inception of this program of corrective exercise for neuropsychiatric patients, experience gained in dealing with the severely disturbed has pointed the way to broader and heretofore unrealized possibilities and is gradually developing a pattern for the employment of therapeutic exercise technics as follows:

1. The patient acutely disturbed is subjected to a situational approach. He is exposed to the desired experience without coercion or overt suggestion that he take part.

2. The patient's skill interests are explored in simple test performance relationships, for example, the ball is thrown to him to see how he handles it and his attention span is observed in various control play situations.

3. The patient is "caught" by the play or exercise experience — that is, his attention is gained and is activated. Planned exercises progressing therapeutically from "interest to effort" are administered.

4. The patient is "held" in exercise by being given definite responsibility. He is instructed in how many movements he must complete and how many plays.

5. Activities are increased and diversified, so that the therapeutic element of progression is always provided.

A new form of psychotherapy, directed to the therapeutic need of the individual and his personality and experience in play skills and exercise has been developed and utilized. The following examples are cited: (*a*) a matter of fact approach or a firm approach being always positive and definite in all contacts for those who need relief of any guilt feeling; (*b*) passivity to aggressions without comment or tolerance by disapproval of aggressions for those who are in need of acceptable expression of aggressions, (*c*) and encouragement by providing opportunities for the development of new interests to provide opportunity for vocational adjustment. In this connection, it should be pointed out that the rationale of prescribed activities provides a means of relating prescribed exercises to higher levels of adjustment, leading to the ultimate job placement, for patients who are able to take advantage of a vocational profile. Thus, for instance, the alert manic patient may be enabled to engage persistently in exercises if made to understand this regimen as being a step toward stabilizing him in certain procedures which will ultimately lead to a definite work project.

The reports received from the Veterans Administration neuropsychiatric hospitals where this program is being prescribed for the acutely disturbed patients indicate that very few or no behavior difficulties are encountered. Once these patients are enlisted in activities of an understandable, interesting and progressive nature, they are more likely to become amenable to the prescribed exercise situation. My own experience,[5] covering a period of seventeen years, shows that the dangerous behavior generally ascribed to these patients exists as a potential rather than an actual condition and that while they are engaged in activities suited to their level of interest and capacity they are not usually dangerous. In fact, during all these years of working in daily contact in the acute wards in a large neuropsychiatric hospital, altercations of any consequence between patients were practically nonexistent. These observations are further confirmed by the experience of our corrective therapists in the field, who find that individual attention to the patient in the acute phase of treatment provides the basis for a most effective therapeutic rapport of cooperative effort, in which the patient becomes more accessible to planned activities.

The Catatonic Patient

The response of the catatonic patient to individualized exercise combined with psychologic elements has been so favorable that he has been compared to the paraplegic patient, whose rehabilitation has represented a significant advancement in physical medicine. In these patients a combination of simple sensory excitation and fundamental exercises progressing to new associations and mental processes awakens not only mentation but social awareness and social activity. Principles of educational retraining are added to assist stuporous types to regain individual recognition of shape, size, design, color and utilitarian value of common objects. Number writing and simple handwriting technics are also employed to activate mental processes and association therapy aids the patient to recall word symbols, such as ball, baseball, etc., while he is actually handling the object.

Impulsive and unpredictable behavior outbursts generally associated with such cases in the psychiatric literature are significantly absent, and the patients' improvement is attested by reports in increasing number from the Veterans Administration neuropsychiatric hospitals.

5. Campbell, Duncan D., and Davis, John E.: Report of Research and Experimentation in Exercise and Recreational Therapy, Am. J. Psychiat. 99:915, 1940.

Exercise in Connection With Drastic Shock Treatments

Prior to the use of drastic shock therapy, many negativistic patients were unable to take part in voluntary therapeutic exercises. Barriers of negativism were broken down through psychologic means in certain cases, but the process was long and sometimes uncertain. The treatment by electric and insulin shock causes many of these patients to become more accessible and modifiable. Many patients who prior to shock treatments were indifferent or resistive to exercise now voluntarily accept it and are much benefited by these procedures of physical medicine.

Patients with persistant, acute behavior problems in various psychiatric categories who were unable to adjust to a therapeutically planned exercise or activity situation are now becoming amenable subjects as a result of the prefrontal lobotomy operation. The problem here no longer becomes restricted to the correction of behavior aberrations; it is now the necessity to provide new urges and bases of motivation. After insulin shock treatment, depressed and retarded patients may become more active, at which time carefully graduated exercises are of distinct value. After narcoanalysis has resulted in the breakdown of amnesia and the release of the emotional determinants, the patient is often in need of pleasurable physical activities which will aid in reassociative processes. Maclay,[6] along with many others, has called attention to the fact that reeducative exercises are helpful therapeutic adjuvants, after hypnosis for acute hysteria.

Exercise is graduated for patient types, as for example, quieting exercise for the hyperactive; nonconcentrative types for regressed; stimulative for depressed, and simple philogenetic exercises, such as swimming, for stuporous types.

Psychotherapy and Activity

The employment of practical psychotherapy complements corrective exercise in modernized treatment. Speaking from the vantage point of long experience, Burlingame,[7] affirmed: "I believe that sound physical medicine and psychotherapy in the form of personal tutoring occupy the front ranks in the help which may be offered to the mentally ill."

Myerson[1] believes that any psychotherapy employed by the corrective therapist to be practical in this specialized field should be inspirational. Hoskins[8] has emphasized empathic understanding, suggesting that the therapists seek to promote the cooperative "we feeling" in the patient. Dr. Karl Menninger and his staff have laid the foundation for an analytic psychotherapy providing detailed and specialized therapeutic aims to be achieved and utilization of methods based upon dynamic concepts.

Maclay,[6] of the Mill Hill Emergency Hospital, London, England, has organized an exceptionally effective combination of activity and psychotherapy. "The general therapeutic program is regarded as the background for individual therapy in its physical, psychological and sociological aspects. Exercise is then employed aiming at relaxation, concentration, attention, speed of response and competition."

As the basis for a practical psychotherapy, at the present time in the Veterans Administration, studies are being made of the patient's interest, concentration and activity skills pointing toward the complete goal of rehabilitation. Incentives, whether toward or away from activity and the psy-

6. Maclay, W. S., and Stokes, A. B.: Second Report on the Work and Organic Organization of an Emergency Medical Service Neurosis Center, Mill Hill Emergency Hospital, London, England, Jan. 1, 1941. Suggested Guide for Preparing Prescriptions to Be Used in Medical Rehabilitation, Menninger Foundation, Tokepa, Kan., 1946.
7. Burlingame, Charles C.: Psychiatic Sense and Nonsense, A. M. A. 133:971, 1947.
8. Hoskins, Roy G.: The Biology of Schizophrenia, New York, W. W. Norton Co., 1946, p. 191.

chosomatic relationships in patients with bodily complaints, provide the major consideration. Meyer,[3] laying stress upon the patient's spontaneous activities, explained on many occasions: "The mentally sick patient can tell in his activity what he cannot tell in the formal interview." Mounting case histories attest to the fact that psychotic patients show more freedom of verbal response when talking about activities in which they have actually engaged. They also develop more constructive activities when these are made meaningful through appeal to their physical, as well as their mental, interest.

Conclusion

While it is difficult at this stage of our early experience to delineate the complete field of physical medicine in the over-all rehabilitation treatment of the mentally sick patient, mounting evidence is pointing to broad areas of distinctive applications.

It is quite evident that prescribed exercises may enable the overly active patient to find an acceptable relief from tension and the inactive patient to discover therapeutic areas for improved activity under the stimulus of interest.

Its distinctive value, however, as an integral part of physical medicine is believed, first, to be its naturalness, appealing to the patient's innate capacity, and, second, its diversified forms, meeting his interest as well as physical needs.

Many psychotic patients unable or unwilling to verbalize normally are able to find therapeutic expression through physical exercise; as Adolf Meyer explains: "They can tell in their activity, what they cannot tell in the formal interview."

Medically prescribed activities for social as well as physical ends are gradually becoming part of the total psychotherapy of the psychiatric hospital, in which activities may provide the basis for improved mental attitudes and serve as significant resocializing media.

In the field of diagnosis, physical exercises are also aiding in the establishment of control situations in which data as to what the patient actually does are combined with what the patient says in order to afford a more complete diagnostic profile.

Having succeeded in reawakening these desirable physical expressions in the mentally sick patient, we are today confronted with a continuous scientific problem, the medical problem of transforming these activities into social elements as part of a total pattern of rehabilitation.

Thus it can be readily seen that physical medicine is playing an increasingly important role not only in the treatment but in the diagnosis and the actual rehabilitation of the mental patient and has before it at this time an opportunity to make a significant contribution in modern psychiatric practice.

Discussion

Dr. Charles Brooke (Washington, D. C.): It gives me pleasure to open the discussion on this paper. It is a subject that interests me because of the important role it plays in the physical and mental rehabilitation of the disabled veteran. The inception of this program was brought about by the great interest and foresight of Dr. Donald Covalt. The essayist has had many years of experience in the treatment of mentally disabled hospitalized veterans. The observations and conclusions made are the result of direct contact and close association with the physical and corrective treatment of veterans suffering from psychiatric diseases, following World War I and other wars. This has paved the way for the establishment of an effective Corrective Physical Rehabilitation program for the veterans of World War II, who are now under treatment in the Veterans Administration Neuropsychiatric hospitals.

It has been brought out and should be emphasized, that the purpose and objective of "Corrective Therapy," and the as-

sociated phases of physical medicine, physical and occupational therapy — in conjunction with the Educational and Manual Arts Therapy programs, are designed to hasten the recovery of the mentally ill patient. It also enables those who are eligible to enter a vocational program, giving opportunities for educational courses, and "on the job training" in the many fields.

Cited in the paper presented are several outstanding authorities in the field of psychiatry which substantiates the basic formula for the treatment and management of the several types of neuropsychiatric patients in the Veterans' hospitals. The administration of the various therapeutic exercise technics described is the result of wide experience and careful study of clinical observations in the behavior of certain types of neuropsychiatric patients.

It has been brought out in particular, that individually prescribed exercise is the keynote in the treatment of the acutely disturbed patients and also, for other types of mental conditions.

The Corrective Therapeutic Program that is now operating in the Veterans Administration Neuropsychiatric hospitals is a pioneer adventure and its activities are being expanded to reach more and more patients suffering from various types of mental ailments. In my opinion, the progress made, thus far, has been invaluable and warrants expansion of such activities so as to reach all mentally disturbed patients who are able to be motivated and reconditioned both mentally and physically. The employment of such an exercise program as outlined for neuropsychiatric patients will hasten their discharge from hospitals and enable them to make an adequate adjustment both socially and economically.

This field of endeavor offers fertile ground for the undertaking of research in the application of corrective therapeutic exercises for the neuropsychiatric patient.

The favorable reports and comments received from several of the neuropsychiatric hospitals on the results accomplished by the application of prescribed corrective exercises to the individual patient, as well as to the selected small groups, have been most encouraging. The enthusiam and efforts of Dr. Davis are responsible for the development and extension of the Corrective Therapy program in the neuropsychiatric hospitals.

I would like to emphasize the necessity for the fullest cooperation with the hospital psychiatric staff, the physiatrist and the corrective therapist, in order to efficiently operate a corrective therapeutic unit.

The treatment described shows, that at the preesnt time favorable results are being achieved toward adequate adjustment and rehabilitation of selected types of patients suffering from mental diseases.

Dr. Gerald P. Lawrence (Downey, Ill.): In the discussion of the application of corrective physical measures with neuropsychiatric patients it might be well to mention a new experiment which we are trying in the Veterans Hospital at Downey, Ill.

At Downey Hospital we had an average of about twenty male patients in restraint at one time. We took those patients to the swimming pool. We had the water around 80 F., and we put those men in the pool and allowed them to vent their energies on the water and on each other as long as they did not exceed reasonable play. If they wanted to upset one of the therapists in charge, that was all part of the fun.

We gave them two hours of that, and took them back and they were peacefully ready for dinner. In the afternoon they had another two hours in the water. The result was that since that has been established, sedation has decreased very materially and the number in restraint has averaged three or four, most of them being new patients who have just come to the ward in a disturbed condition.

Three months is only a beginning, but we are very happy with the results and we hope to extend this treatment to the women patients in the near future.

Dr. Davis (closing): I might make a point in reference to some of the projects which are being undertaken at the present time in the Veterans Administration, in addition to the exercise program at the Veterans Administration Hospital, Downey, Illinois, in which individualized exercises gradually reduce hyperactivity in acutely disturbed conditions.

There are other projects being undertaken in which medically prescribed physical exercise is being employed for specific neuropsychiatric conditions. At the Bronx, VA Hospital, New York City, there is a combined research project being conducted by the neurosurgeons, psychiatrists, psychologists, social workers and corrective physical rehabilitation personnel in a program of specialized activity to be used after leukotomy. These types of patients are intensely interesting. They represent, in many cases, persistent behavior abberations which have not been alleviated by avaliable modalities. Authorities inform us that the rationale of this operation is to dissociate by surgical means pathologic thinking from its emotional reverbations. After the operation there is generally a marked alleviation of tension. This presents a motivational problem of reawakening old urges to activity and creating new ones. It will be interesting to see if the use of corrective activities through physical reactivation and the reawakening of pleasureable preformed play pattern will be effective in these cases as a part of the total psychotherapeutic procedure.

It is generally agreed that leukotomy requires a psychologic follow up by socializing and resocializing activities through which the patient may be enabled to reorient himself to normal living. Medically prescribed exercises carrying out psychiatric aims are becoming increasingly important psychotherapeutic aids in this new area of treatment.

THE USE OF A TETANIZING CURRENT IN MYASTHENIA GRAVIS *

Report of a Case

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Myasthenia gravis, a disease of unknown origin, was first described by Willis in the seventeenth century. It usually appears between the ages of 20 and 40 years, and women seem to be more frequently affected than men. The neuromuscular dysfunction in myasthenia gravis is characterized by an abnormal muscular weakness probably due to transmission fatigue which is manifest during voluntary exercise and/or during indirect stimulation with the tetanizing current. This weakness or fatigability can usually be alleviated (in the early stages at least) by rest or the ingestion of adequate doses of neostigmine bromide which depresses the amount of cholinesterase present normally and so strengthens the action of acetylcholine on the muscle to produce contractions. Most frequently the extractacular muscles are at first affected, a ptosis of one or both eyelids being the first outward symptom of the disease. As the disease progresses, the muscles of mastication, the masseter muscles and those of the pharynx and tongue are next involved. The disease may be localized in one or several of the cranial nerves or it may spread to involve the extremities and/or the trunk. Remissions occur during which the patient may be free from symptoms for months or years. Conservative therapy advocates rest and neostigmine. The validity of a rest program may be questioned on the basis of a weak muscle becoming weaker unless it is allowed to carry out its normal function.

Watkins[1] has pointed out that the dangers of fatiguing muscles have been overemphasized. It is our belief that the involved muscles in a patient with myasthenia gravis could be kept in normal tone if exercised judiciously. It has been our experience that such exercises should be given after the administration of neostigmine and that the elapsed interval should not exceed seventy minutes. It is within this period that we have noted the best responses. An electrical procedure was utilized by us in the treatment of myasthenia gravis, and it is the purpose of this paper to present the data accumulated during a three month period in which selected muscles were stimulated by the tetanizing current.

Report of Case

G. S., a white man, aged 53, reported to the physical therapy department on Jan. 11, 1947. He had most of the physical signs characteristic of myasthenia gravis (fig. *A*). A ptosis involving the right eyelid was noticeable, and the patient was supporting the mandible with his hand because of masseter muscle weakness. He was making an

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1. Watkins, A. L.: Physical Medicine and Neurology, Clinics 4:1486 (April) 1946.

effort to keep his head in a position of extension, a conscious endeavor on the part of the patient to (1) compensate for the ptosis and (2) prevent the head from dropping towards the chest. In the five years that had elapsed since the onset of the disease, the patient had lost 60 pounds and appeared emaciated. On palpation, muscles revealed a high degree of atonicity. Seventy-five minutes before his admission to the physical therapy department, the patient had taken 30 mg. of neostigmine. The masseter muscles were selected for an electrodiagnostic test and, as expected, showed a typical Jolly reaction.[2] Five contractions were elicited from the right masseter muscle and seven from the left. (An electrodiagnostic test is considered confirmatory of the presence of myasthenia gravis when a nerve or muscle, on being rapidly stimulated with the tetanizing current responds normally but weakens progressively with each subsequent contraction, fading out completely

A, appearance on admission, seventy-five minutes after ingestion of 30 mg. of neostigmine bromide; *B*, appearance on discharge.

if stimulation is maintained. The response to the galvanic curernt is normal. Such a reaction is known as the Jolly, or myasthenic, reaction.

In the establishment of a treatment program for this patient, it was decided that an attempt should be made to increase, if possible, the strength of the muscles and prevent progressive atrophy of disuse. As this could not be done on a basis of voluntary muscular work, electrical stimulation was employed. A tetanizing current was selected because it closely approaches the character of the normal motor nerve impulse and uses the same mechanism in exciting the muscle as does the normal motor nerve. (It should be remembered that a muscle responds to the tetanizing current only by virtue of the continuity of the motor nerve fibers supplying it.)

Treatment After Testing for Fatigue. — On the assumption that electrical stimulation might be effective at least in diminishing the atrophy of disuse, two muscles were selected for treatment in an endeavor to prove or disprove the usefulness of such a procedure. The muscles selected were the masseters, since they are markedly affected in myasthenia gravis and since they are the most accessible to electrical stimulation. As the stimulating current was not measurable with available apparatus, dosage was judged by muscular response which was maintained at a maximum level.

Treatment was begun on January 12, and the test results were used as a guide to determine the number of contractions to be elicited during treatment (shown in detail in the table). We felt that it would not be advisable to approach the fatigue point too closely; if the fatigue test showed forty contractions, treatment might be given for approximately twenty-five contractions. During the first treatment only five contractions were elicited from the left masseter and three from the right, but the current strength was increased to produce greater muscular tension than did the current strength used in the tests. Tests to determine the maximum number of contractions (so-called fatigue tests) were performed at frequent intervals, and when the number of contractions obtainable before fatigue

2. Kovács, R.: Electrotherapy and Light Therapy, ed. 5, Philadelphia, Lea & Febiger, 1942, pp. 126.

set in was greater than on the preceding test the number of contractions used in treatment during the following week was increased.

A relationship may be said to exist between our fatigue test and DeLorme's[3] "maximal load." In our method emphasis is placed on the maximum number of contractions elicited by a tetanizing current, whereas DeLorme stresses maximum weight with few repetitions; in his method the weight load is not static but increases with increase in the patient's lifting ability; ours call for repetition of contractions with the load (mandible unchanged.

This procedure furnished a guide to the number of contractions to be used during treatment, and at no time in its use did the patient's muscles show signs of fatigue.

Combined Fatigue and Treatment Chart.

Date	Fatigue Tests —No. of Contractions— Left Masseter	Right Masseter	Treatments —No. of Contractions— Left Masseter	Right Masseter
1/11	7	5	.....	.....
1/12	.....	.....	5	3
1/13	.....	.....	10	7
1/18	120	103	.....	.....
1/25	200	200	.....	.....
1/26	.....	.....	60	60
1/28	110*	90*	.....	.....
1/29	.....	.....	110	110
2/17	300	300	.....	.....
2/19	.....	.....	200	200
3/1	400	400	.....	.....

* Test performed six hours after administration of neostigmine bromide; all other tests and treatments done seventy-five minutes after administration of the drug.

Technic. — A dispersive electrode, 6 by 4 inches, well moistened with warm tap water and connected to one of the leads from the machine, was placed beneath the cervical portion of the spine. As the patient was resting directly on the electrode, it was not necessary to secure it in any way. An active electrode measuring ½ inch in diameter, well soaked in warm tap water and attached to the other lead, was placed on the motor point of the masseter muscle. The active electrode had an interrupter key, which, when pressed, allowed the current to flow. We feel that this type of electrode is superior to those without the key arrangement from the fact that the electrode does not have to be removed from the motor point during treatment. In the treatment of the muscles in myasthenia gravis, prolonging the actual contraction time is not desirable, as it produces rapid transmission fatigue. Therefore, each stimulation was brief. All tests and treatments were done not over seventy-five minutes after 30 mg. bromide of neostigmine had been taken orally.

Results. — Improvement was noted within a week. In the fatigue tests, a greater number of contractions were produced without reaching the absolute fatigue point. After the patient had received the second treatment, ten contractions were elicited from the left masseter. Five days later in a fatigue test the number was 120. The number of contractions produced at treatment sessions between the aforementioned dates was seven. On January 25, a fatigue test showed that the originally weaker right masseter had caught up with the left one, with 200 contractions elicited. After this test, sixty treatment contractions were given to each masseter.

The patient lost the numbness on the right side of the face, which had been present since the onset of the disease. A drooling from the side of the mouth, a source of considerable annoyance to the patient, had ceased. On palpation, the masseters appeared to be of normal tone, and, as the patient stated, "My face seems to be alive again." During this time the patient's morale had improved considerably.

Beginning on January 18, an effort was made to determine the number of voluntary contractions the patient was capable of performing. He raised the mandible to within ½ inch of complete closure ten times. The low number of repetitions was perhaps due to the fact that he had previously had a fatigue test, although he was allowed some rest before beginning the voluntary motion. By February 6, the patient was able to completely close the jaws 100 times. Although his muscles were not tired, it was decided to forego these voluntary tests because there was some evidence of respiratory embarrassment.

On January 28, six hours after ingestion of 30 mg. of neostigmine, another fatigue test was done. (All other tests and treatments were given seventy-five minutes after similar doses of neostigmine, as this was the elapsed time between the initial dose and the first

3. DeLorme, T. L.: Heavy Resistance Exercises, Arch. Phys. Med. 27:607 (Oct.) 1946.

Jolly test.) He was considered to be at the therapeutic state called low. With the same current strength as in all the preceding fatigue tests, 110 contractions were elicited from the left masseter and 90 from the right. We considered this to be an excellent response.

On February 17, after approximately five weeks of treatment, the patient responded with 300 contractions from each masseter in the course of a fatigue test. A few days later his treatment quota was increased from 110 to 200 contractions. At no time during treatment was there subjective or objective evidence of tiring. Worthy of note at this time was the patient's reaction to a cessation of treatment for several days. He said, "I seemed to miss the stimulating effects of the electric current." When asked to be more explicit, he said: "My face seems to be more alive when I get daily treatment."

On the forty-seventh day following his initial treatment, the final fatigue test was carried out. Four hundred contractions were elicited from each masseter, an increase of approximately 400 per cent in forty-seven days. We felt at this time that our objective, that of increasing the strength of the masseter muscles, had been reached.

Treatment was then reduced from six to three times weekly with inclusion of the sternocleidomastoid and the trapezius muscles. These muscles were very weak after the effects of the neostigmine bromide had worn off. Stimulation of these muscles was carried out through the spinal accessory nerve, which is accessible to such stimuli. The fatigue point was higher in these muscles than expected, and it was decided to stimulate each 100 times.

Subjective improvement was noted almost immediately. The patient stated: "After electrical treatments, even when I get low on neostigmine, there is less tendency of my head to wobble." Other clinical improvement was manifest objectively on palpation of the treated muscles, which showed an appreciable increase in tone and some hypertrophy. He was able to close his jaws completely (fig. *B*).

The patient stated that he felt better than at any other time since the onset of the disease, five years previously, but a general improvement comparable to that found in the masseter muscles was not in evidence. It was the opinion of the neurologist-in-chief that the patient was definitely benefited. At this point he was discharged from the hospital.

Summary

For a period of forty-seven days, a patient with myasthenia gravis was alternately tested and treated by use of a tetanizing current to the masseter muscles. Progressive improvement in voluntary closure of the jaw and in response to electrical stimulation was observed.

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AN EVALUATION OF HEMOIRRADIATION THERAPY *

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LOS ANGELES

Introduction

Since the discovery of the biochemical effects of ultraviolet radiation, numerous procedures have been devised to direct this emanation toward the control of disease. Of recent years the irradiation of the blood has received considerable attention both in this country and abroad. The bulk of information relating to this technic derives from clinical trials.[1] The general pattern of these reports includes a description of technic followed by a series of cases subjected to hemoirradiation with or without other forms of therapy. The experimental investigations of Blundell, Erf, Jones and Hoban,[2] and of Toomey and Takacs [3] fail to suggest a *modus operandi* through which the uniformly spectacular results claimed by the clinical reports might be explained.

In view of the lack of agreement between clinical and laboratory reports on the results of hemoirradiation we have carried out the studies here described.

Experimental Investigations

The studies undertaken were designed to test, first, the possible antibacterial results of hemoirradiation and, second, the influence of hemoirradiation upon toxemia, as exemplified by botulinus poisoning.

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* Read at the Twenty-Fifth Annual Session of the American Congress of Physical Medicine, Sept. 3, 1947.

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Irradiations in the work reported here were made using the Knott Hemo-Irradiator. The technic employed was similar to methods described by Knott, Miley and others and is related in detail under the headings of the separate experiments. The water-cooled Burdick lamp was calibrated photometrically and shown to give the values recorded in table 1. These measurements were made with the Burt ultraviolet photometer through the quartz window of the blood irradiation chamber at a distance of 1.2 cm. and represent the ultraviolet radiation which actually reached the blood flowing through the chamber. The activity of the lamp was also evidenced by the catalytic decomposition of oxalic acid and by the production of skin erythema. Coagulation of the blood used was prevented by the addition of 6 mg. of ammonium oxalate and 4 mg. of potassium oxalate per 5 cc. of blood, delivered in solution.

TABLE 1. — *Calibration of Burdick Water-Cooled Ultraviolet Lamp Used with the Knott Hemoirradiator.*

Ultraviolet Region	Gm./Cal./Sq. Cm./Min.
2,000 to 2,540 A	0.157
2,540 to 3,080 A	0.071
3,080 to 3,220 A	0.041
3,220 to 3,300 A	0.009
Total Ultraviolet Reaching Chamber	0.278

Direct Bactericidal Effect of Irradiation

In these determinations the bacterial species being studied were grown in nutrient broth, a culture of eighteen to twenty-four hours being used in each case. At the time of testing, the culture was diluted in the selected vehicle and passed through the irradiation chamber of the Knott Hemo-irradiator. Control specimens were obtained by closing the shutter during the period of passage through the chamber. The pump was set to deliver blood at a rate of 10 cc. per 22 seconds. Immediately after passage through

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2. Blundell, C. P.; Erf, L. A.; Jones, H. W., and Hoban, R. T. Effect of Ultraviolet Irradiation (Knott Technic), on Bacteria and Their Toxins Suspended in Human Blood and Appropriate Diluents, J. Bact. 47:85, 1944.

3. Toomey, J. A., and Takacs, W. S.: Ultraviolet Irradiation of Blood in Treatment of Experimental Poliomyelitis, Am. J. Dis. Child. 66:605, 1943.

the chamber, the control and irradiated suspensions were diluted and plated for counting. Dilutions of each sample were plated. At least five agar plates were counted at each dilution.

A. Irradiation of Escherichia Coli. — 1. Suspended in Isotonic Sodium Chloride Solution: A twenty-four hour culture of the bacterium was diluted 1:100 in isotonic sodium chloride solution. After irradiation dilutions were made in sodium chloride, and 1 cc. of each dilution was plated on esosin-methylene blue agar. Counts were made after forty-eight hours of incubation at 37 C. Results are given in table 2. The average numbers of bacteria per plate in both irradiated and nonirradiated samples are listed. It is customary to count only those dilutions which show a number of bacteria between 5 and

TABLE 2. — *Bacterial Counts After Irradiation of E. Coli in Isotonic Sodium Chloride Solution.*

Dilutions of Bacteria	Average Number of Bacteria/cc. Nonirradiated	Irradiated
$1x10^{-6}$	5	0
$1x10^{-5}$	66	0
$1x10^{-4}$	Over 300 (uncountable)	10
$1x10^{-3}$	Over 300 (uncountable)	67
Average	5,800,000/cc.	84,000/cc.

200. A larger number of bacteria per plate are uncountable and are so listed.

2. Suspended in Whole Blood: One cubic centimeter of two twenty-four hour broth cultures of E. coli was added to 99 cc. of whole human blood. After thorough mixing, the inoculated blood was passed through the irradiating chamber at the rate of 10 cc. per 22 seconds.

TABLE 3. — *Bacterial Counts After Irradiation of E. Coli in Whole Blood.*

Dilutions of Bacteria	Average Number of Bacteria/cc. Nonirradiated	Irradiated
	Experiment 1	
$1x10^{-6}$	134	128
$1x10^{-5}$	Over 300 (not countable)	Over 300 (not countable)
Average	134,000,000/cc.	128,000,000/cc.
	Experiment 2	
$1x10^{-6}$	15	14
$1x10^{-5}$	135	131
Average	14,000,000/cc.	13,600,000/cc.

The results (table 3) show that, although a considerable reduction in the number of viable organisms results from irradiation of a saline suspension, this effect is absent in the presence of whole blood.

B. Irradiation of Staphylococcus Aureus. — 1. Suspended in Isotonic Sodium Chloride Solution: One cubic centimeter of a twenty-four hour culture of Staph. aureus was added to 99 cc. of isotonic sodium chloride solution. The suspension was passed through the chamber at a speed of 10 cc. per 22 seconds. A control sample was removed before the shutter was opened. After passage through the chamber, dilutions were made and plated in nutrient agar. Results appear in table 4.

2. Suspended in whole blood: One cubic centimeter of a twenty-four hour culture was added to 99 cc. of whole blood and mixed thoroughly. The

procedure was carried out as previously described. Results are shown in table 5.

C. Irradiation of Bacillus Mycoides. — 1. Suspended in Isotonic Sodium Chloride Solution: One cubic centimeter of a twenty-four hour suspension of B. mycoides was added to 99 cc. of isotonic sodium chloride solution and treated as previously described. Results are shown in table 6.

TABLE 4. — *Bacterial Counts After Irradiation of Staph. Aureus in Isotonic Sodium Chloride Solution.*

Dilutions of Bacteria	Average Number of Bacteria/cc. Nonirradiated	Irradiated
$1x10^{-6}$	16	0
$1x10^{-5}$	145	0
$1x10^{-3}$	Over 300 (uncountable)	4.2
$1x10^{-2}$	Over 300 (uncountable)	33.0
Average	15,000,000/cc.	3,700/cc.

TABLE 5. — *Bacterial Counts After Irradiation of Staph. Aureus in Whole Blood.*

Dilutions of Bacteria	Average Number of Bacteria/cc. Nonirradiated	Irradiated
	Experiment 1	
$1x10^{-6}$	9	8
$1x10^{-5}$	111	83
Average	10,000,000/cc.	8,000,000/cc.
	Experiment 2	
$1x10^{-6}$	49	55
$1x10^{-5}$	(Over 300 (not countable)	Over 300 (not countable)
Average	49,000,000/cc.	55,000,000/cc.

TABLE 6. — *Bacterial Counts After Irradiation of B. Mycoides in Isotonic Sodium Chloride Solution.*

Dilutions of Bacteria	Average Number of Bacteria/cc. Nonirradiated	Irradiated
$1x10^{-4}$	26	0
$1x10^{-3}$	101	0.8
$1x10^{-2}$	Over 300 (not countable)	8.2
Average	180,000/cc.	800/cc.

TABLE 7. — *Bacterial Counts After Irradiation of B. Mycoides in Whole Blood.*

Dilutions of Bacteria	Average Number of Bacteria/cc. Nonirradiated	Irradiated
	Experiment 1	
$1x10^{-4}$	36	40
Average	360,000/cc.	400,000/cc.
	Experiment 2	
$1x10^{-5}$	19	16
$1x10^{-4}$	177	167
Average	1,800,000/cc.	1,600,000/cc.

2. Suspended in Whole Human Blood: One cubic centimeter of a twenty-four hour broth culture was added to 99 cc. of whole blood. Results appear in table 7.

These results can be summarized by stating that when the micro-organisms suspended in isotonic saline solution are exposed to the action of the ultraviolet lamp, a marked reduction in the numbers of bacteria occurs. However, when the micro-organisms are suspended in whole blood, there is no reduction in the number of viable organisms. These observations concur with those made by Blundell and co-workers,[2] and indicate that hemoirradiation cannot be effective through a direct bactericidal action.

Effect of Ultraviolet Irradiation Upon the Toxin of Clostridium Botulinum

In 1946 Miley[1u'] described the treatment of a patient with suspected botulism, using the hemoirradiation technic. Because of the apparently beneficial results and because Blundell and co-workers did not include the botulinus toxin among those studied, we investigated the effect of blood irradiation upon animals given injections of this toxin. Since this toxin is known to be destroyed by ultraviolet radiation, we did not attempt to demonstrate this effect again. Instead, we proceeded directly to the experiment in vivo. Botulinus toxin used in the work was of type A, obtained through the courtesy of Dr. I. S. Daniels, of Lederle Laboratories. The toxin was tested in mice to give an approximate lethal dose, and the minimum lethal dose for rabbits was then determined. The toxin was diluted so that 0.5 cc. injected intraperitoneally into rabbits weighing 7 to 9 pounds resulted in death in about 80 per cent of the animals in 36 to 74 hours. It was felt that, although feeding the toxin would simulate the natural disease more closely, the degree and rate of absorption of the toxin would be more variable than if the toxin were injected. Since it is known that absorption from the peritoneal cavity is rapid and complete, this avenue seemed preferable. One-half hour after injection, 15 to 20 cc. of blood (2 to 3 cc. per pound) were removed by cardiac puncture, oxalated and immediately passed through the irradiating chamber at a speed of 10 cc. per 22 seconds. It was thought that by this time much, if not all, of the toxin would have been absorbed by the blood stream and opportunity would be afforded for a maximum direct effect upon the toxin present in the irradiated blood. The irradiated blood plus sufficient isotonic sodium chloride solution to wash the chamber was reinjected into the animal via the marginal ear vein.

Two groups of control animals were prepared. In one group the blood was irradiated as in the test group but no toxin was administered. Any unfavorable action to the process of hemoirradiation should be reflected in this

TABLE 8. — *Effect of Hemoirradiation on Experimental Botulism.*

Experimental Group Irradiated and Inoculated		Control Groups Irradiated But Not Inoculated		Not Irradiated But Inoculated	
Animal	Time of Death, Hours*	Animal	Time of Death, Hours*	Animal	Time of Death, Hours*
1	36-40	1	S	1	36-40
2	36-40	2	S	2	36-40
3	36-40	3	S	3	36-40
4	36-40	4	S	4	48
5	36-40	5	S	5	48
6	36-40	6	S	6	48
7	60	--	--	7	60
8	60	--	--	8	72
9	72	--	--	9	84
10	84	--	--	10	84
11	S	--	--	11	S
12	S	--	--	12	S
Mean survival time.....50.4		--	--	----	55.4

* S indicates that the animal survived.

group. The second control group consisted of animals receiving the toxin but no irradiation.

After treatment, the animals were segregated in groups and survival times observed.

Results. — The results of the test are shown in table 8.

It is seen at once that there is no significant difference between the two groups of animals and that the hemoirradiation had no effect upon the course of the illness as to either the total number of animals surviving or the number of hours of survival. These findings are in accord with those of Blundell and his associates[2] dealing with staphhylococcic scarletinal, diphtherial and tetanal toxins.

Comment

There is without question a contradiction between the laboratory evidence and the clinical reports accumulated in the studies on ultraviolet irradiation of blood. In order to compare the two, it is necessary to evaluate the scientific accuracy of each. In the laboratory, every effort is made to establish controls; in clinical studies, controls are not always adhered to. However, research has established methods for studying human material accurately. If the therapy of a disease is to be evaluated clinically, both treated and untreated groups must be compared. This does not imply that a consecutive series may be compared with a previously observed untreated group, no matter how accurate the records of both groups may be. The use of alternate or simultaneous cases is required under identical conditions of supplementary therapy.

For example, many claims for the cure of pneumonia have been advanced over the years. Despite the numerous supposedly efficacious methods of therapy, recent, carefully controlled studies by numerous workers indicate that the death rate from all these methods is the same. Even immune serum, which received such wide use before present chemotherapeutic methods, has questionable therapeutic value, except in certain serologic types of pneumonia. Chemotherapy has contributed an appreciable and statistically significant reduction in the mortality from the disease. Similar examples pertaining to most diseases may be collected from the extensive medical literature of the past hundred years.

If the clinical evidence offered in support of hemoirradiation therapy is examined this same lack of acceptable experimental technic is found. Miley[1u] has reported a clinically diagnosed case of botulism apparently cured by hemoirradiation. The diagnosis was not verified by the finding of the botulinus toxin in the suspected food, and cure can be claimed only when the diagnosis has been verified.

The same author, in another paper, reports favorable results with ultraviolet blood irradiation therapy of apparently intractable asthma.[1t] Although 120 consecutive patients were treated with blood irradiation, there were no controls cited. Other therapy given at the same time, including epinephrine and ephedrine inhalants, complicate the picture and do not contribute to the accuracy of the report.

Miley again claims value for the method in acute pyogenic infections.[1o] This report includes 103 cases without controls; a brief statement adds that 63 patients received no chemotherapy and 40 did. There is no attempt to evaluate the effect of this chemotherapy, and in our opinion the significance of the results is dubious.

A survey of the entire clinical literature[1] on the subject leads us to conclude with Bradley[1n]: "The variety of cases studied is good, but their num-

ber is insufficient and controls are lacking. Further work is needed both in animal experimentation and in well controlled series of cases before definite judgment can be passed."

Since our experimental findings corroborate those of Blundell and his co-workers[2] and Toomey and Takacs,[3] we feel that the evidence against the value of the procedure permits us to state that further clinical work on ultraviolet hemoirradiation should be confined to controlled observations on an experimental basis until the method is thoroughly evaluated. The use of this procedure on patients tends to displace methods of proved efficacy and should be discontinued, except for controlled clinical study.

Many workers have been impressed with the theoretical possibilities of the method. It has been known for a long time that ultraviolet radiation will alter proteins, thereby killing bacteria or even destroying toxins. However, the problem in Knott's method is to reconcile the theoretical value of ultraviolet irradiation with its value in irradiating from 200 to 300 cc. of opaque fluid, such as blood, for ten seconds. For example, in botulism, in which there is no demonstrable toxin in the blood at the time of the appearance of symptoms, it is difficult to understand how the procedure can affect the disease. In septicemias, assuming the sterilization of 200 cc. of blood (which has proved not to be the case experimentally), one cannot understand a therapeutic effect when bacteria occur in the remainder of the blood and in the focus or foci of infection. Theoretically, one must assume an autocatalytic action.[11] This has not been demonstrated. The increased oxygen capacity of the blood, claimed by some to follow hemoirradiation, and the report of secondary emanations lack confirmation. The introduction of these emanations as possible proof of the value of the method should await more definite information as to their existence; even if present, they would not necessarily be significant.

Conclusions

1. Ultraviolet irradiation of the blood containing experimentally added bacteria (species Staph. aureus, E. coli and B. mycoides) produced no decrease in the number of viable bacteria.

2. Autotransfusion of irradiated blood had no effect upon the mortality rate or time of survival in rabbits given small doses of botulinus toxin.

3. The studies reported here offer no basis for the use of hemoirradiation in the treatment of infections. The results of earlier investigations are confirmed.

4. An examination of the clinical reports reveals a lack of proper control series and ambiguous criteria of therapeutic results.

5. Any further clinical studies should be made according to a program which would provide adequate means for evaluation of the procedure.

Discussion

Dr. G. J. P. Barger (Washington, D. C.): I am in agreement with the essayists that ultraviolet irradiation of the blood containing experimentally added bacteria produced no decrease in the number of viable bacteria. In the early days it was thought that there was a direct lethal effect, but it was found out that this was not the case—rather, the disappearance of septicemias, verified by blood cultures before and after blood irradiation and by clinical recovery, was actually more a subtle process, requiring twenty-four to forty-eight hours. A similar interval was required to bring about inactivation of toxins, as evidenced in improvement of definite toxic symptoms in the clinical picture.

I further agree with the statement that the studies reported here offer no basis for the use of hemoirradiation in the treatment of infections. It is, however, to be regretted that Dr. Moor and his colleagues stopped here after spending so much time and money to repeat that which had already been demonstrated.

The essayists cannot be more aware of

the deficiencies of some of the clinical reports than were the authors of papers published. Some thirty-three such articles have been published.

I cannot, however, agree with the conclusion drawn as the result of their work, also that of Blundell and Toomey, that, therefore because these studies did not explain the results presented, that further clinical work should be confined to controlled observation on an experimental basis until the method is evaluated.

The clinical work with a new therapy of necessity runs far ahead of the scientific research to provide its rationale, but the clinical work is essential from which to choose the research problems.

In the meantime we shall go on building on such scientific facts as we have and on the basis of a widening clinical experience, which cannot but arouse interest.

Dr. Robert E. Hoyt (Los Angeles): We don't wish to be put in the position of obstructing the development of science, or even being suspected of it; but we must all agree that science can advance only in a well-integrated and orderly way.

One of the first things we must recognize is that no disease is invariably fatal, and we find that variations in severity of infections frequently make it difficult to evaluate results. We all remember that when sulfapyridine was being used on pneumococcus infections it looked better than it was because it happened to be used during a period of mildness in the disease. Likewise, we have variations in the individual's resistance. So it is not particularly worth while to continue treating patients without trying to make some objective form of measurement to determine whether or not they are responding to the therapy or just getting well as they might anyhow.

Fortunately, we have very definite means for evaluating the results of a treatment, and these do not require any expense, they don't require effort and they can be applied by any one.

First of all, we have the principle of using nonselected series; not picking good or bad risks, but treating the patients by order of admission, and either by treating alternate cases or simultaneous cases we can evaluate the effects of the therapy.

We have certain yardsticks that have been devised, including the mean survival time and the standard deviation of this value, which will tell us whether the results are good, bad or indifferent.

This sort of thing is opposed to what we speak of among ourselves as a testimonial type of study, where the patient is evaluated in a subjective way, asked whether he feels better, and you decide whether you think he looks better, because some patients do survive almost any disease. If we choose and select and evaluate groups in the proper way, then we can decide whether the treatment is beneficial or not.

There is no experimental evidence published which would validate the use of hemoirradiation and there is considerable against it. The statement that these reports we made only indicate material which is well-known and accepted, isn't quite correct, because I haven't found any reference to the treatment of a pathologic condition in an animal by irradiation of that animal's blood, as is recommended in the treatment of the patient. We have done so and have found no benefits in the cases we have studied.

We wish to close with the statement that so far there has been no objective clinical data released which permits us to evaluate the therapy by hemoirradiation, and all our experimental work and that of all others reported indicates it is not of value.

BACK ISSUES NEEDED

The Central Office asks for back issues of the ARCHIVES.

MEDICAL NEWS

Physical Medicine at the New York State Medical Meeting

The following program was presented in the Session on Physical Medicine as a part of the meeting of the New York State Medical Society:

Herbert Kraus, New York, N. Y., The Role of Physical Methods in Diagnosis; discussion opened by Sidney Licht, Cambridge, Mass.

Kristian G. Hansson, New York, N. Y., Rehabilitation in Poliomyelitis; discussion opened by Hart E. Van Riper, New York, N. Y. (by invitation).

William Bierman, New York, N. Y., Present Day Education in Physical Medicine; discussion opened by Richard Kovacs, New York, N. Y.

Dr. Robert L. Bennett Speaker

Dr. Robert L. Bennett presented the subject "Adequate Care of Poliomyelitis" at the annual session of the Medical Association of Alabama, held recently in Mobile.

Dr. Louis Newman Guest Speaker

Dr. Louis B. Newman was guest speaker at the Conference of the National Rehabilitation Association and Office of Vocational Rehabilitation on May 4, 1948, which was held in South Bend, Ind. Dr. Newman, who is Chief of the Physical Medicine Rehabilitation Service at the Veterans Administration Hospital, Hines, Ill., presented an illustrated lecture on the Rehabilitation Program in the Veterans Administration.

Report of Committee on Cerebral Palsy

The Joint Legislative Committee to Study the Problem of Cerebral Palsy has presented a report to the Legislature outlining a program to provide medical care, rehabilitation and special education for victims of the disease. The report recommended the establishment of seven centers for diagnosis and evaluation, three within New York City; revision of the formula for state aid to local school districts as it pertains to special education for the physically handicapped; the construction of a state hospital home for those too severely handicapped to live at home, an increase in the number of such cases to be cared for at the New York State Reconstruction Home at West Haverstraw; the development of an enlarged training center and a practice school for teachers of handicapped children at Buffalo State Teachers College; increased training of medical and other personnel needed for the full care of such children, and the immediate development of a plan to discover the names of all children in the state who suffer from orthopedic handicaps.

Dr. Fulton Honored

The British Embassy has announced that Dr. F. Fulton is to be honored for his contribution to the Allied war effort in the field of science. Dr. Fulton will be made an honorary officer of the Civil Division of the Most Excellent Order of the British Empire. His award is to be given "in recognition of the important part he played in the liaison in medical science between the United States and the United Kingdom during the critical days of the war."

Dr. Fulton recently gave the fifth annual D. J. Davis Lecture on Medical History at the University of Illinois College of Medicine. His subject was "The position of William Withering in the history of scientific medicine."

University Opens New Hospital

George Washington University took possession of its new four hundred bed hospital March 19. The hospital occupies a city square, contains one hundred and twenty single and one hundred and eight double rooms, eighteen wards and forty beds for resident physicians and interns, six air conditioned major operating rooms, and three smaller ones, nine air-conditioned delivery rooms, nurseries, noise abatement devices, and motion picture equipment to record operating room technics. A large amount of space will be devoted to laboratories and research units.

VA News

Research Projects. — The Veterans Administration has thirty-five general research laboratories in operation in hospitals affiliated with class A medical schools. The VA hopes that such laboratories will be established in all fifty-four veterans' hospitals which operate in conjunction with medical schools and in some of the nonaffiliated hospitals. In addition, six laboratories for radioisotope research and therapy will be established this year and three more next year.

New Chiefs of Services. — Dr. Roy A. Wolford of Washington, D. C., has been appointed assistant medical director for Professional Service in the VA Department of Medicine and Surgery.

Dr. Harvey J. Tompkins of Arlington, Va., has been appointed as head of the neuropsychiatric service in the department of medicine and surgery to succeed Dr. Daniel Blain, who resigned to become medical director of the American Psychiatric Association.

Lecture Program in VA. — A medical lecture program in VA hospitals is offering residents and other medical personnel the opportunity to learn

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ARCHIVES of PHYSICAL MEDICINE

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL MEDICINE

.·. EDITORIALS .·.

NEUROPHYSIOLOGY IN PHYSICAL MEDICINE

The importance of a working knowledge of the fundamental science, neurophysiology, in the practice of physical medicine is well illustrated by several papers in this issue of the ARCHIVES. Fay,[1] writing about physical therapy in cerebral palsy, brings to the field of clinical therapeutics certain applications of neurophysiologic observations in the laboratory. He has emphasized the basic reflex patterns usually functioning in a balanced fashion and automatically in the normal, which may be utilized to stimulate movement patterns in this group of patients. It is the duty of the therapist to be familiar with these fairly complicated types of movements which may exist at the lower motor levels of the midbrain, medulla and upper spinal cord and to know how to utilize them in voluntary motor re-education. Although his article does not attempt to cover completely the field of physical therapeutics in cerebral palsy, the principle of specifically stimulating reflexes in the prone lying position rather than supine is one which can be utilized in a variety of clinical conditions.

Knapp's[2] hypothesis offered as an explanation of the much debated subject of "spasm" in poliomyelitis again brings the physiatrist deep into the physiology laboratory; in fact, perhaps further than the laboratory workers have as yet been able to explore thoroughly. The complexity of the motor pathways seems to increase with our widening knowledge of neurophysiology achieved by workers such as Lloyd and Lorente de Nó,[3] who have made use of the more accurate and sensitive electronic instruments developed recently. It seems most likely that one must look further than the anterior horn cell lesions in poliomyelitis to explain certain aspects of muscle hyperirritability and shortening. The internuncial cell theory offers an attractive explanation for at least some of the unexplained clinical findings.

The whole problem of spasticity of muscles has recently been summarized in a masterly fashion by Magoun and Rhines.[4] In their short monograph they have made understandable to the clinician the influence of the stretch-reflex and extrapyramidal systems in the production of spasticity which we incorrectly used to consider simply as due to loss of inhibitory action of the pyramidal system. Thorough study of this text and the important references will give the physiatrist a better background on which to base a program of scientific physical therapy for upper motor neurone disease.

The report of the use of electrical stimulation in the treatment of myasthenia gravis[5] brings up a subject which one might have supposed to have

1. Fay, T.: The Neurophysical Aspects of Therapy in Cerebral Palsy. Arch. Phys. Med, 29:327 (June) 1948.
2. Knapp, M. E.: A Hypothesis to Explain the Muscular After Effects of Poliomyelitis. Ibid. 29: 334 (June) 1948.
3. Lorente de Nó, R.: Analysis of the Activity of the Chains of Internuncial Neurons, J. Neuro-Physiol. 1:207 (May) 1938.
4. Magoun, H. W., and Rhines, R.: Spasticity. The Stretch-Reflex and Extrapyramidal Systems. Pp. 59, Springfield, Ill., Charles C. Thomas, 1947.
5. Rudd, J. L., and Cullinan, J. F.: The Use of a Tetanizing Current in Myasthenia Gravis, Arch. Phys. Med. 29:354 (June) 1948.

been well closed. The results obtained, using progressively increasing stimulation, suggest that this may be a useful adjunct in selected cases. Much more careful clinical research is necessary, however, before conclusions can be drawn. It would be helpful to have careful ergographic and electromyographic studies together with as much objective evidence of the general clinical course as possible, for spontaneous remissions make the evaluation of therapeutic procedures precarious. It is difficult to visualize how electrical stimulation could improve muscle strength, if the neuromuscular defect is simply one of abnormal transmission fatigue. We may have to revamp somewhat our ideas of neurophysiologic disturbance after further studies.

Davis[6] has clearly demonstrated the value of certain physical therapeutic procedures in the treatment of neuropsychiatric patients. One would like to have in this instance better understanding of the physiologic processes involved, but so far it has been impossible to perform basic laboratory experiments in this field. Certain technics have been devised, however, to explore by clinical physiologic investigations the combined fields of psychiatry and physical medicine, and information of considerable clinical application can be expected to result from this type of neurophysiologic research.

6. Davis, J. E.: Corrective Physical Rehabilitation for Neuropsychiatric Patients, Arch. Phys. Med. 29:345 (June) 1948.

PHYSICAL MEDICINE AND THE AMERICAN MEDICAL ASSOCIATION

The issue of the *Journal of the American Medical Association* for May 8, 1948, once more indicates the growing appreciation for the expanding field of physical medicine on the part of the officers and members of the American Medical Association. Not only does this issue contain all the papers presented in the panel on physical medicine at the Atlantic City meeting of the American Medical Association, but it also presents, among the reports of the officers of the Association, many references to physical medicine. The panel discussion includes thirteen pages of material on physical medicine in relation to general practice as presented by outstanding authorities in physical medicine. In addition, on pages 157 and 158, appears the report of the Council on Physical Medicine; on page 161 appears the report on the rehabilitation program of the Council on Industrial Health; on page 165 appears the announcement of the program on health and fitness of the Bureau of Health Education; on page 172 appears a description of the exhibit on physical medicine presented at the Atlantic City session by the Bureau of Exhibits; on page 190 appears the announcement of the approval of the American Board of Physical Medicine by the Council on Medical Education and Hospitals, and on page 192 appears the announcement of the approval of a Session on Physical Medicine for the Chicago session of the American Medical Association by the Council on Scientific Assembly. The mere fact that the various councils and bureaus of the American Medical Association are giving such close attention to many phases of the field of physical medicine, including rehabilitation and physical fitness, gives striking evidence of the rapidly growing interest in this specialty on the part of many groups of medical practitioners. Physiatrists can be truly proud of the rapid advance of interest in physical medicine among the officers and members of the American Medical Association as a whole.

Medical News
(Continued from page 366)

about the latest developments in medicine from some of the nation's leading specialists and lecturers.

Participants in the lecture program, as well as topics to be presented, are selected by the manager, in collaboration with the hospital's Deans Committee. If the hospital has no Deans Committee, the manager may obtain advice and recommendations from hospital and branch office consultants. Before contracting for speakers, hospital managers must obtain authorization from the Department of Medicine and Surgery in the VA Central Office in Washington, D. C. Authorizations remain in force until June 30, 1949. After that date, they are to be renewed annually. Lecturers are paid personal expenses, including transporation.

International Poliomyelitis Conference

Twenty international medical and scientific authorities will present papers on poliomyelitis at the First International Poliomyelitis Conference to be held in New York City, July 12-17.

Following presentation of papers at each of the conferences, plenary sessions, the speakers will join with a panel of authorities for an open-floor discussion on particular phases of the disease. At one session, official government delegates, who have been invited from 64 nations, will present summaries on poliomyelitis problems in their homelands.

Speakers and titles of their papers follow: Dr. Albert B. Sabin, professor of research pediatrics, University of Cincinnati, Cincinnati, Ohio, "Epidemiological Patterns of Poliomyelitis in Different Parts of the World." Professor H. J. Seddon, medical director, Wingfield-Morris Orthopaedic Hospital, Oxford, England, "Economic Aspects of Management of Poliomyelitis." During the session on the early stage of poliomyelitis, delegates will hear three speakers — Dr. Irvine McQuarrie, head, Department of Pediatrics, University of Minnesota, Minneapolis, Minn., "The Evolution of Signs and Symptoms"; Dr. David Bodian, associate professor of epidemiology, The Johns Hopkins University, Baltimore, Md., "The Pathological Anatomy," and Dr. Fritz Buchtal, director, Institute of Neurophysiology, University of Copenhagen, Copenhagen, Denmark, "The Pathological Physiology." Dr. John A. Anderson, head, Department of Pediatrics, University of Utah, Salt Lake City, Utah, will discuss "Diagnosis and Treatment" in the management of the disease during the early stage. Three speakers will discuss the convalescent stage of poliomyelitis—Dr. E. T. Bell, professor of pathology, University of Minnesota, "Progressive Pathology"; Dr. Arthur L. Watkins, chief of physical medicine, Massachusetts General Hospital, Boston, Mass., "Progressive Disabilities," and Dr. Ralph K. Ghormley, consultant on orthopedic surgery at Mayo Clinic, Rochester, Minn., "Progressive Deformities."

Dr. William T. Green and Dr. Joseph S. Barr, both clinical professors of orthopedic surgery at Harvard University, Boston, Mass., will present papers on management of the disease. Dr. Green's paper will be on the convalescent stage of the disease and Dr. Barr's on the late stage.

Three authorities will be at the speaker's rostrum for the session on bulbar poliomyelitis. They will be Dr. K. T. Neubuerger, professor of pathology, University of Colorado, Denver, Colo., "The Pathology"; Dr. A. B. Baker, professor of neurology, University of Minnesota, "The Diagnosis," and Dr. James L. Wilson, professor of pediatrics and communicable diseases, University of Michigan, Ann Arbor, Mich., "The Treatment."

Presenting papers on immunology and chemotherapy in the disease will be Dr. Isabel M. Morgan, assistant professor of epidemiology at The Johns Hopkins University, "Mechanisms of Immunity in Poliomyelitis"; Dr. John R. Paul, professor of preventive medicine, Yale University, New Haven, Conn., "Immunogenic and Other Types of Poliomyelitis Viruses," and Dr. Raymond N. Bieter, professor of pharmacology, University of Minnesota, "Experimental Chemotherapy."

There will be three speakers at the session on public health aspects of epidemic poliomyelitis. They will be Dr. Joseph G. Molner, Deputy Commissioner of Health in Detroit, Mich., "Public Health Measures"; Dr. C. W. Munger, director, St. Luke's Hospital, New York City, "Hospitalization," and Elizabeth P. Rice, director of social service, Grace-New Haven Community Hospital, New Haven.

Thermal Sedation

According to experimental evidence recently reported by Cowles and Nelson of the Department of Preventive Medicine, University of California at Los Angeles, a tremendous field awaits study of the effects of altering body temperature on the course of disease, especially when toxic factors are concerned. Their conclusion was based on a study of the effects of low temperatures on the symptoms of tetanus toxin in the desert iguana. With the moderate cooling (27 C.) there was a material prolongation of life, the first symptoms being delayed till the end of three days and death till the seventh or eighth day. With the chilled group (10 C.) no symptoms were noted till the end of the experiment (fourteen days). Tests of larger series of animals and greater standardization of the toxic dose are now in progress. The preliminary tests, however, clearly show that lowering of temperature definitely prolongs life in the desert iguana and give rise to the hope that similar procedures may be successful adjunctive therapies in certain human toxic diseases.

Apparatus Accepted

Hanovia One Burner Group Irradiation Alpine Ceiling Lamp. — This lamp, Model 2137, is an ultraviolet radiation generator and is designed to be fastened to the ceiling. Regulation of the intensity of the ultraviolet radiation is controlled from a floor-type cabinet. It has five steps of intensity control. The burner is a high-pressure low-voltage mercury arc lamp in a quartz tube and requires 700 watts of electrical power. The transparent fused quartz tube is provided at each end with electrodes of the incandescent tungsten filament type.

The central fixture consists of a hood which may be suspended from the ceiling in the middle of the room at a distance of about 2.1 meters (7 feet) above the cots. The firm claims that at this distance the maximum intensity of radiation, 3,130 angstroms and shorter, on the cots with the control set for minimum intensity is 200 microwatts per square centimeter. This intensity will produce an erythema on the untanned skin after five minutes' exposure.

The lamp was investigated in a clinic acceptable to the Council and the claims of the manufacturer were confirmed.

The Council on Physical Medicine voted to include the Hanovia One Burner Group Irradiation Alpine Ceiling Lamp, Model 2137, in its list of accepted devices.

Hanovia "Lighthouse" Portable Large Group Irradiation Ultraviolet Lamps. — These lamps, Models 2143 and 2145, are sources of ultraviolet radiation. They are the same in most particulars except the power consumption and intensity of radiation output; Model 2143 has a 550 watt burner and Model 2145 has a 700 watt burner. The generating lamp is of the high-pressure low-voltage mercury arc type and is enclosed in a quartz tube. The assembled apparatus is designed to be set in the center of a room to permit the simultaneous irradiation of a group of 12 or more patients in the standing position, the lamp being about 1.2 meters (4 feet) above the level of the floor.

One lamp (Model 2143) was investigated in a clinic acceptable to the Council on Physical Medicine. This lamp produced a minimal erythema dose on untanned skin in five minutes at a distance of 2.1 meters (7 feet) as claimed by the manufacturer. The appearance and durability of the apparatus were good.

The Council on Physical Medicine voted to include the Hanovia "Lighthouse" Portable Large Group Irradiation Ultraviolet Lamps, Models 2143 and 2145, in its list of accepted devices.

Artron Sun Lamp, Type A, Acceptable. — The Artron Sun Lamp, Type A, is of the bulb type, containing a filament within a small quartz capsule that houses the mercury arc. The power required for operation is 275 watts on a 110 to 125 volt A. C. circuit. Except for the fact that it bears the etched name "Artron," this lamp is identical with the Hytron Sun Lamp, Type A, manufactured by the Hytron Radio & Electronics Corp. It is similar in construction to the General Electric and Westinghouse lamps of Type RS. The Artron Sun Lamp is made especially for the Affiliated Retailers, Inc., Empire State Building, New York 1.

An investigator for the Council verified the erythematogenic effectiveness of the lamp. He made three exposures, side by side, of the untanned inner upper arm, at a distance of 24 inches (61 cm.) from the front edge of the lamp, for periods of five, ten and fifteen minutes, respectively. After three hours, the fifteen and ten minutes exposures were very red and the five minute exposure showed a faint reddening. One day later only the ten and fifteen minute exposures were still red. They were still red three days after the irradiation, but they were not tender as they would be if there had been blistering. He concluded that the manufacturer's recommendation of exposure not longer than five minutes was correct.

The Council on Physical Medicine voted to include the Artron Sun Lamp, Type A, in its list of accepted devices. — [J. A. M. A. 136:690 (Mar. 6) 1948.]

Apparatus Not Acceptable

California Dri-Aire Lamp. — The California Dri-Aire Lamp is essentially an infra-red lamp. It stands on the floor, is adjustable in height, can be set at various angles and has a shepherd's crook neck so that its rays can be directed on a bed or on a seated patient.

The firm states that the lamp operates on either direct or alternating current, requires 110 volts and draws 500 watts of electrical energy. According to the manufacturer, "Its intensity can be increased or decreased by moving the lamp closer or away from the person using it. The coating on the element cuts down rays such as ultraviolet and intensifies the infra-red," and the lamp has approval of Underwriters' Laboratories.

The illustrations in the advertisements show an object that looks like a switch attached to the power supply wire. However, the lamp sent to the Council office for examination had no switch and had to be turned off by pulling out the plug.

The firm submitted copies of a full page advertisement. Much emphasis is laid on the ability of this lamp to "provide a zone of warm, dry air similar to the soothing, quality air of the desert." There is, of course, nothing in the lamp to exercise a special dehumidifying effect; by heating the air in its vicinity it reduces the relative but not the absolute humidity. It cannot, obviously, make dry desert air out of the humid air of a hot day in Chicago, for example. Thus the firm's claim that the apparatus "brings soothing, healing, dry, warm desert air wherever and whenever you want it" is misleading. The classification which includes neuritis and sacroiliac pain among "circulatory ailments" is inaccurate.

On the basis of its construction, which shows no advantages over similar products of other manufacturers, and of the advertising, which contains inadmissible claims, the Council on Physical Medicine voted not to include the California Dri-Aire Lamp in its list of accepted devices. — [J. A. M. A. 136:691 (Mar. 6) 1948.]

Experimental Program for Polios

A five-year program of total care for polios and other orthopedic patients, covering psychologic, social, emotional, educational and vocational treatment simultaneously with medical, was inaugurated in January at Orthopedic Hospital, Los Angeles, under a $100,000 grant from the National Foundation for Infantile Paralysis. Many of the recommendations of Dr. Morton A. Seidenfeld, NFIP Director of Psychological Services, will be embodied in the program. Among other things, Dr. Seidenfeld recommended teamwork on the part of the physician, the nurse, the physical therapist, the social worker, the patient and his family. Dr. Charles L. Lowman, Orthopedic Hospital's chief of staff, emeritus, is the head of the project. He will be assisted by professional personnel in the fields of medicine, nursing rehabilitation, social work and psychology.

Physical Therapists in the Army

Subsequent to July 1, 1948, physical therapists on duty in Army Hospitals must be either Regular Army officers or members of the Officers' Reserve Corps. Public Law 36, 80th Congress, signed April 16, 1947, authorizes a Women's Medical Specialist Section of the Officers' Reserve Corps. Original appointments in this section remain in effect for five years regardless of duty status.

Reserve officers may request extended active duty, or choose to remain on an inactive status which will in no way interfere with their civilian employment. It is anticipated that extension courses and active duty of 15 days or longer for training purposes will be available.

The Army is desirous of appointing a large number of physical therapists as members of the Women's Medical Specialist Corps Section of the Officers' Reserve Corps. It is the policy of the Department of the Army that these officers would not be required to serve on active duty without their consent except in time of a national emergency.

Interested physical therapists who wish to take advantage of this opportunity may obtain further information by writing to The Surgeon General, United States Army, Washington 25, D. C., Attention: Colonel Emma E. Vogel, Chief, Women's Medical Specialist Corps.

Identification of Trademarks

A recent letter from Carson P. Frailey, Executive Vice-President and Secretary of the American Drug Manufacturers Association, calls attention to the growing practice of using trademarks to indicate the source and genuineness of pharmaceuticals and chemicals and asks that such words be clearly identified as trademarks in published articles. It has been the policy of THE ARCHIVES to begin all trademarked terms with a capital letter, and this policy is in line with Mr. Frailey's request; as a result, inconsistencies in capitalization may occur in short compass within a single sentence if trademarked terms are used in association with terms in the general domain. It happens that the trademarked name of a popular brand of table tennis equipment has become widely used as the name of the game; when this name is used in a series with baseball, basket ball, golf and other names of games, the capitalization becomes unsightly, and consequently the manuscript editor replaces this name with the descriptive term "table tennis." This may perhaps explain to some of our authors why corrections (?) which they have made on galley proofs have been ignored. If a pharmaceutical is produced by a number of manufacturers, the official name or the name accepted by the Council on Pharmacy and Chemistry of the American Medical Association is used unless it is clear that the effects produced were due to a particular brand of the drug and not to the drug itself.

Louis Lefkoe Memorial Foundation Offers Prize

The Louis Lefkoe Memorial Foundation offers a prize of $250.00 for the most worthwhile original contribution to the medical knowledge of Osteitis Deformans (Paget's Disease).

The paper is to be in the customary format for publication of medical literature. It may cover any aspect of the subject, such as pathogenesis, biochemical knowledge, pathology, treatment, etc.

The paper is to be submitted to the trustees of the foundation on or before April 5, 1949, the birthday of Louis Lefkoe, in whose memory the foundation was created.

The prize is open to anyone who can contribute to the medical knowledge of the subject.

Multiple Sclerosis Clinics

The first research clinic in a projected series to investigate multiple sclerosis was opened March 29 at the Beth Israel and Boston State hospitals, Boston, through a grant from the National Multiple Sclerosis Society.

Meeting of American Hearing Society

The National Conference of the American Hearing Society was held at the William Penn Hotel, Pittsburgh, May 19-22 under the presidency of Dr. C. Stewart Nash. Physicians speaking at the conference included: Dean M. Lierle, Iowa City, Recent Advances in the Medical Treatment of Deafness. Morris Fishbein, Editor, The Journal, Chicago, Is It Worth Hearing? Emily A. Pratt, Washington State Department of Health, Prevention and Conservation of Hearing.

Among other subjects discussed were goals of group activities in hearing societies, hearing aid advisory centers, aural rehabilitation of adults and educational program for children with a hearing loss.

BOOK REVIEWS

ANNUAL REVIEW OF PHYSIOLOGY. *Victor E. Hall,* Editor, Stanford University; *Jefferson M. Crismon,* Associate Editor, Stanford University. Volume X. Fabrikoid. Price, $6.00. Pp. 552. Stanford University. Annual Reviews, Inc., and American Physiological Society, 1948.

For those physicians who desire to keep informed of the latest developments in the field of medicine publication of the Annual Review of Physiology is always warmly welcomed. In the present volume there are no less than twenty-three chapters each devoted to a particular subject and presented by a recognized authority in his field. The object of the Board of Editors is to secure contributions from physiologists of highest rank throughout the world. In the present volume there are four reviews from overseas; two from England, one each from Australia and New Zealand.

Schmitt and Denues of the Department of Biology at Massachusetts Institute of Technology review the literature presented from 1944 to 1947 on the physical properties of protoplasm. Of importance to those interested in nerve and muscle pathology is the excellent discussion of the work of Young of London and Weiss of Chicago on the physical properties of nerve fibers. Weiss and Taylor observed that proximal to an applied constriction the axons greatly distend while distal to the constriction the fiber diameter decreases; on release of the constriction the swellings spread distally. Weiss concludes there is a continuous flow of exoplasm peripherally from the cell body. Young likewise infers a continuous pressure and flow from the cell body along the axon with fluid loss through the surface. This flow constitutes the "trophic" influence of the cell body, maintaining the fiber type.

The physiologic aspects of genetics is discussed by Beadle of California Institute of Technology. The writer states the biological sciences appear to be in the midst of a period of unprecedented progress. There is a general recognition of the significance of genes in the economy of the organism. In bacteriology, Beadle states one sees the effects of an altered point of view toward genetics. He states it now becomes acceptable to speak of bacterial genes.

Developmental physiology is ably reviewed by Nicholas of Yale. The physiology of reproduction is reviewed by Reynolds of the Carnegie Institute of Washington. The greatest emphasis he says has been concerned with mechanisms associated with pregnancy. Stress has been laid on histochemical phenomena and the distribution of enzyme systems in reproductive tissues. Significant advances have been made in respect to relaxin, to a knowledge of hyaluronidase in semen and to the metabolism of spermatozoa.

An excellent review of conduction and synaptic transmission in the nervous system is given by Eccles of New Zealand. Eccles has restricted his review to a critical survey of such fundamental problems as: permeability of the plasma membrane; cell metabolism and the plasma membrane; acetylcholine metabolism and the nerve impulse; the membrane theory of the nerve impulse; neuromuscular transmission; synaptic transmission in ganglia; synaptic transmission in the spinal cord; and neurophysiology of the retina.

McCulloch of the University of Illinois gives an excellent review on the somatic functions of the central nervous system in the limited space allotted.

Of special interest to clinicians is the review of vision by Chapanies of Johns Hopkins University. The digestive system is reviewed by Vass of St. Thomas' Hospital Medical School, London. The review of the peptic ulcer literature is worthy of attention.

An outstanding chapter is the review on blood cytology by Osgood of the University of Oregon. He paid especial attention to folic acid, nitrogen mustards, urethane and stillbamide. This writer adds greatly to the value of his review by giving a critical comment of the articles discussed. Those interested in the leukemias will find this of marked interest.

Another chapter of great interest to clinicians is the review of the heart by McMichael of the University of London, England. The method of right heart catheterization for the determination of cardiac output is given a prominent place as is the pharmacology and metabolism of the heart.

Another splendid contribution is the chapter on peripheral circulation by Zweifach of Cornell. Hypertension is well reviewed and some attention is devoted to shock. Wilhelmi of Yale has made an excellent review of the very important and pertinent subject, the metabolic aspects of shock. Respiration is reviewed by Hitchcock and Whitehorn. Of immediate value is their section on resuscitation, pressure breathing and clinical applications. Anoxia in aviation is reviewed by Nims of Yale and will be of particular interest to those interested in aviation medicine. The regulation of energy exchange is reviewed by Brobeck of Yale, and metabolic functions of the endocrine glands by Evelyn Anderson of the University of California. The subject of heat and cold is ably covered by Lee of the University of Queensland, Australia. This chapter should appeal to the physiatrist and is worthy of his attention. Sweating is another chapter reviewed by List. The physiatrist will find this most profitable reading.

Pharmacology is ably covered by Geiling of the University of Chicago. Smith and Flynn review the literature of coagulation of the blood, and Virginia Kneeland Frantz reviews the important subject of hemostasis. This is a most valuable review particularly for the surgeon. The references represent two new concepts in surgery: the acceleration of clotting by local application of thrombin preparations, and the staunching of hemorrhage by tamponnade but modified by preparations which can be left with impunity in the closed wound to be absorbed. Horsley Gantt of Johns Hopkins reviews the literature on physiological psychology.

A chapter that should be read by everyone is the physiologic effects of radiant energy by Dobson and Lawrence of the University of California. They have attempted to bring out the highlights of recent developments on the biologic effects of radiation from such sources as the atomic bomb. They place emphasis on short wavelength electromagnetic radiation, x-rays and gamma rays, and on particulate radiations, alpha rays, beta rays, neutrons and fission fragments. The work reported which might prove effective in preventing and treating pathologic changes has been ably presented.

This volume is a mine of valuable information and should be in the library of every physician.

CINEPLASTY. By *Henry H. Kessler,* M.D., Ph.D., Formerly Captain (MC) U. S. N. R.; Formerly Chief of Amputation Center, United States Naval Hospital, Mare Island, California; Orthopedic and Amputation Consultant to the Office of Vocational Rehabilitation; Member of New Jersey Rehabilitation Commission; Diplomate of American Board of Orthopedic Surgery. Cloth, 201 pp. with 314 illustrations. Price, $6.75. Springfield, Illinois: Charles C. Thomas, 1947.

This excellent book by one of the foremost authorities on the management and rehabilitation of the amputee is much more than a description of the cineplastic methods for activation of the prostheses of persons who have lost upper extremities. Although the book does provide the last word in information on cineplastic technics, it also contains other information. Kessler, whose exhibits on rehabilitation of the amputee have been highlights of recent meetings of the American Medical Association, presents his whole philosophy of the need for physical restoration, psychologic readjustment, vocational guidance and training and selective placement of the amputee. The profuse number of illustrations adds greatly to the value of this text. The book consists of twelve chapters as follows: (1) general considerations, (2) functions of the upper extremity, (3) mechanical prosthesis, (4) cineplasty—history, (5) cineplasty—physiology and anatomy; (6) cineplasty—surgical technic, (7) cineplasty—after-care and complications, (8) cineplastic prosthesis, (9) congenital amputations, (10) double-arm amputations, (11) plastic procedures, and (12) rehabilitation.

As Vice-Admiral Ross T. McIntire has stated in the foreword, "Doctor Kessler, from a wide experience both in civilian and military practice, has written a book designed to assist all who deal with the rehabilitation of the amputee."

Doctor Kessler's book offers new hope for the person who has lost an upper extremity, and anyone interested in cineplasty will find that this is a "must" book. All physicians interested in rehabilitation of the amputee will find many points of interest in this text. It is highly recommended.

ORTHOPEDIC SURGERY FOR NURSES INCLUDING NURSING CARE. By *Philip Lewin,* M.D., F.A.C.S., Professor of Bone and Joint Surgery, Northwestern University Medical School; Professor of Orthopedic Surgery, Post Graduate Medical School of Cook County Hospital; Attending Orthopedic Surgeon, Cook County Hospital; Senior Attending Orthopedic Surgeon, Michael Reese Hospital; Consulting Orthopedic Surgeon, Municipal Contagious Disease Hospital; Lecturer to the Cook County School of Nursing and Michael Reese Hospital; Formerly Colonel, M.C., A.U.S., Mayo General Hospital. Fourth Edition. Cloth. Pp. 563, with 255 illustrations. Price, $3.75. Philadelphia: W. B. Saunders Company, 1947.

This is the fourth edition of an interesting, fairly inclusive textbook of orthopedic surgery for nurses. Extensive revisions and additions have been made in the text and illustrations in order to keep pace with the many advances in orthopedic diagnosis and management during the recent war years.

The sections on infantile paralysis, preoperative and postoperative measures, anesthesia, intravenous therapy, blood transfusions, and water balance have been revised, and the section on fractures, dislocations, adhesive strapping, circulatory disturbances of the extremities, physical and occupational therapy, and treatment of back and knee have been expanded. The use of sulfa drugs, penicillin, and streptomycin is discussed as a whole and also in specific conditions.

It is of interest to the physiatrist that the author states in the preface: "Even though the nurse may not be especially interested in either physical therapy or occupational therapy, she should become acquainted with these specialties in order to do her part in the general physical rehabilitation program." Furthermore, he devotes a complete chapter to the principles and general technics of physical therapy and occupational therapy.

This book is highly recommended to nurses specializing in orthopedic surgery, to the nursing school librarian, and to the physical therapist interested in orthopedic management.

TREATMENT IN GENERAL PRACTICE. By *Harry Beckman,* M.D., Professor of Pharmacology, Marquette School of Medicine, Milwaukee, Wisconsin. Sixth Edition. Cloth. Price, $11.50. Pp. 1126. Philadelphia and London: W. B. Saunders Company, 1948.

This is the sixth edition of a widely used, dependable encyclopedia of treatment in general

practice in which the author has included over three hundred disease states. The various entities have been grouped conveniently into twenty-five chapters according to etiology, and the treatment of each disease is discussed in a very clear and concise manner presenting the various present day accepted methods of management in considerable detail. The author skillfully avoids didacticism by critically analyzing the various therapeutic technics and by giving adequate references to the available literature.

To those who are already familiar with this book, it need only be said that the author has effectively brought the text up to date. In doing so, it was necessary to rewrite a considerable portion of the book. In addition, the following entities have been included for the first time: Balantidiasis, Coccidiosis, Colorado Tick Fever, Creeping eruption, Geotrichosis, Listerellosis, Loeffler's syndrome, Management of penicillin reactions, Melioidosis, Mite infestations, Moniliasis, Newly differentiated anemias, Non-meningococcal meningitides, North Queensland Tick typhus, Pulmonary aspergillosis, Reiter's syndrome, Rickettsialpox, Thrombosis and Embolism.

It is of interest to the physiatrist that the author lists more than sixty diseases in which physical therapeutic agents are of significance in the regimen of treatment.

This book is highly recommended to internists and general practitioners as an adequate up to date guide to the treatment of diseases encountered in general practice.

THE INTERNAL FIXATION OF FRACTURES. By *Charles Scott Venable,* M.D., F.A.C.S., Diplomate, American Board of Surgery; Member, Fracture Committee of the American College of Surgeons, American Academy of Orthopedic Surgeons, Southern Surgical Association, American Association for the Surgery of Trauma, Texas Surgical Society; and *Walter Goodloe Stuck,* M.D., M.S. (Orth. Surg.), F.A.C.S., Diplomate, American Board of Orthopedic Surgery; Member, Fracture Committee of the American Academy of Orthopedic Surgeons, Southern Surgical Association, American Orthopedic Association, American Association for the Surgery of Trauma, Texas Surgical Society. With a foreword by *Ralph K. Ghormley,* M.D., F.A.C.S., Professor, Orthopedic Surgery, Mayo Foundation; Consultant, Orthopedic Surgery, Mayo Clinic; Consultant, Orthpedic Surgery, Veterans Administration. First Edition. Cloth. Price, $5.50. Pp. 237, with 81 illustrations. Springfield, Illinois: Charles C. Thomas, 1947.

This book presents a thorough discussion of the methods of treating fractures by means of internal fixation. It includes a complete history of the development of the use of these methods. The various appliances used in the past and at present are discussed, described, and well illustrated in the text. The book contains an extensive bibliography pertaining to each phase of the subject. Following a discussion of the history of internal fixation and of the metals used, the authors describe the various technics in use at present. They clearly indicate that internal fixation is not the method of choice in all types of fractures. The indications for operation are described, and the fractures are listed in which good results can be anticipated with this method of treatment.

The authors are conservative in the discussion of the results for fractures treated by these methods. Complications and reasons for failure are carefully presented. In a number of fractures, they recommend the older technics of plaster fixation or various methods of traction and immobilization. This book does not include a discussion or presentation of the recently favored method of immobilization of fractured bones by means of metal pins and external splinting devices.

This book will be of interest primarily to the orthopedic surgeon; however, the physiatrist who sees many fracture patients in his work will be interested in this comprehensive discussion of the treatment of fractures.

OLD PEOPLE: REPORT OF A SURVEY COMMITTEE OF THE PROBLEMS OF AGEING AND THE CARE OF OLD PEOPLE. Under the Chairmanship of *B. Seebohm Rowntree,* C.H., LL.D. Paper. Price, $1.50. Pp. 202, with 28 illustrations. Published for the Trustees of The Nuffield Foundation by Oxford University Press, 114 Fifth Ave., New York 11, Amen House, Warwick Sq., London, E. C. 4, 1947.

This survey was made to provide a proper basis for the "care and comfort of the aged poor" as an objective of the Nuffield Foundation, as well as to make a contribution to a pressing social question. The introduction states that while most published statistics relating to old age take the "pensionable" ages of 65 and 60 as being synonymous with the beginning of old age, it is realized, however, that people over these ages include two distinct and separate categories, namely: those under, say, 70, who are merely elderly but who, for the most part, are still capable of leading substantially normal lives, though at a somewhat reduced tempo; and those above that age, who tend, in most cases, to become really old, with an accelerating diminution of intellectual and physical power, and with consequently reduced ability to lead normal and independent lives. It also states that the change which is taking place in the age-distribution of the population will, in the not very distant future, result in so great a preponderance of those in the older age-groups that, unless the able-bodied among them continue at work after they reach pensionable age, the bur den of maintaining the aged may become so great as to result in a lowering of the national standard of living.

The main topics considered in the report are: Incomes of the old; Housing and living conditions; Homes and institutions; Recreation; The old in employment. While the conditions reported are naturally primarily related to Great Britain, many of the conclusions and recommendations of the closing chapter are of sufficient general interest. Among these are recognition of a coun-

try's limited resources of wealth and labor, emphasized in Lord Beveridge's words: "It is danderous to be in any way lavish to old age until adequate provision has been assured for all other vital needs, such as the prevention of disease and the adequate nutrition of the young." The report finds that the vast majority of the aged are independent, that the administration of many endowed charities are confused, that better provision should be made for the aged among the long-term sick, that more recreation is needed, employment is both beneficial and necessary and there is need for further study and a balanced policy based on well-informed public opinion.

FUNDAMENTALS OF PSYCHIATRY. By *Edward A. Strecker,* M.D., Sc.D., LL.D., Litt.D., F.A.C.P. Professor of Psychiatry and Chairman of the Department, Undergraduate and Graduate Schools of Medicine, University of Pennsylvania; Psychiatrist to the Pennsylvania, Philadelphia and Germantown Hospitals; Consultant and Chief-of-Service, Institute of the Pennsylvania Hospital; Consultant to the Surgeon General, U. S. Navy; Formerly Consultant for the Secretary of War to the Surgeons General of the Army and the A.A.F.; Senior Consultant in Psychiatry, Veterans Administration; Consultant in Mental Hygiene; U.S.P.H.S.; Chairman, Committee on Psychiatry, National Research Council; Chairman, Committee on Psychiatry, American National Red Cross. Fourth Edition. Pp. 325 with 21 illustrations. Cloth. Price, $4.00. Philadelphia, London and Montreal: J. B. Lippincott Company, 1947.

The first edition of this book appeared in 1942 and its well deserved success is proven by the fact that there have been four editions since. The chief virtue of Strecker's volume is that it brings essential and up to date information in compact and easily readable form. In this edition there has been considerable rewriting, and a brief chapter on psychosomatic psychiatry has been added.

CORNELL CONFERENCES ON THERAPY. VOLUME II. Edited by *Harry Gold,* M.D., Managing Editor; *David P. Barr,* M.D.; *Eugene F. DuBois,* M.D.; *McKeen Cattell,* M.D.; *Paul A. Bunn,* M.D., and *Walter Modell,* M.D. Cloth. Price, $3.75. Pp. 354. New York: The Macmillan Company, 1947.

The Cornell Conferences on Therapy were inaugurated in 1937 at Cornell University Medical School-New York Hospital to provide a forum for the informal exchange of views between the Department of Medicine, the Department of Pharmacology and practitioners of medicine on problems of treatment. Volume II comprises a series of 16 conferences selected from the total of more than 100 that have been published in the past few years. The choices were so made as to insure appropriate distribution of emphasis on new discoveries and basic principles, and with due consideration of the wide range of readers: general practitioners, specialists, surgeons, teachers, internes, medical students, pharmacists, nurses and others. The list of conferences presented in Volume II covers: The use of placebos in therapy; treatment of poliomyelitis; treatment of meningitis; treatment of syphilis; treatment of rheumatic fever; oral penicillin; choice of sympathomimetic amines; the management of gallbladder disease; principles of treatment of edema and dehydration; treatment of edema by drugs; uses and abuses of quinidine; treatment of coronary artery disease (two chapters); treatment of some tropical diseases; surgical treatment of hypertension and evaluation of local antisepsis. Of interest to physiatrists will be Dr. K. G. Hansson's discussion in the chapter, "Treatment of Poliomyelitis." In all, the discussions are participated in by thirty-eight distinguished authorities. The discussions of all of the conferences are published, one conference appearing every month in the *New York State Journal of Medicine* and one every other month in the *American Journal of Medicine.* Volume II, as did Volume I, makes intensely interesting and valuable reading.

THE METABOLIC BRAIN DISEASES AND THEIR TREATMENT IN MILITARY AND CIVILIAN PRACTICE. By *G. Tayleur Stockings,* M.B., B.S., D.P.M. Late Deputy Medical Superintendent, City Mental Hospital, Birmingham. Late Senior Assistant Medical Officer, Warlingham Park Hospital. Late Major, Specialist in Psychological Medicine. R. A. M. C. Ernest Hart Medical Scholar, British Medical Association. Cloth. Pp. 250. Price, $4.50. Baltimore: The Williams & Wilkins Company, 1947.

In these few pages the author attempts to explain the metabolic and physiologic mechanisms instrumental in the production of mental disorders with considerable space given over to the theories responsible for the reactions resulting from shock therapy for these conditions. The author presents his subject with the boastful omission "of the usual masses of figures, percentages and statistics" and although most readers will agree with his claim that "there is nothing more tedious and hypogenic than the perusal of a medical treatise which consists mostly of interminable columns of figures and statistics strung together with a few badly constructed sentences and paragraphs of indifferent English," it is questionable whether his generalizations can be accepted without further evidence.

He proposes that the mechanics at fault in psychotic patients is glycogen synthesis and glucose oxidation in brain tissue and that "mental disturbances of a gross nature can be produced purely as a result of interference with the normal cerebral respiratory process." A statement that "physical signs pointing to a generalized disturbance of the metabolic functions are found in a large proportion of patients with metabolic encephalopathy" requires better proof than "unhealthy, muddy skin, wasting, dehydration, foul breath, coated tongue and sordes encrusted lips, tachycardia and unnaturally brilliant eyes." The few specific allusions to physiologic changes are too summarily discussed to be convincing.

In consideration of the etiologic factors for "metabolic encephalopathy" certain diseases are thought to be the precipitating factors such as hepatitis and malaria, various physical agents as heat and injury and several drugs. Atabrine,

or the English namely mepacrine, is singled out as a drug "in subjects with an idiosyncrasy to the drug may be disastrous and some of the most malignant forms of dysglycia may be precipitated in this way." A statement which should be documented for the experience of the American observers does not agree that the drug per se is the responsible factor for mental disorders. Certainly other drugs might better be used as examples.

Electric shock therapy or his term, electroanoxia, and insulin shock therapy are discussed as to indications, technic and results. His theory is that these agents produce "a sudden chemical and metabolic change in the biochemical activities of the whole body and particularly in the cerebral respiration — mechanisms; alterations being affected directly through a change in the oxygen-glucose metabolism of the brain and indirectly through a concomitant stimulation of the autonomic nervous system." This all sounds well but the explanations fail to be rational and are not adequate.

The author does not lack enthusiasm and optimism as evidenced by such statements that "metabolic encephalopathy is a curable and preventable condition" and that if early treatment is given "90 per cent cure rate in early cases might well become a possibility." Certainly the therapy he advocates has not secured such results in other hospitals or clinics.

The book is the author's conception of mental diseases and would be the cause for much controversy. Many psychiatrists should be annoyed by this work and students will be confused.

METHODS OF DIAGNOSIS. By *Logan Clendening,* M.D., F.A.C.P., Late Professor of Clinical Medicine and History of Medicine, University of Kansas School of Medicine, and *Edward H. Hashinger,* M.D., F.A.C.P., Professor of Clinical Medicine, University of Kansas School of Medicine. First edition. Cloth. Price, $12.56. Pp. 868, with 143 illustrations. St. Louis: The C. V. Mosby Company, 1947.

This book on diagnosis is based on the teaching material used by the late Dr. Logan Clendening in his courses on physical diagnosis given at the University of Kansas School of Medicine. The book is written in a very terse and informal style characteristic of these authors. It includes many interesting illustrations, good illustrative cases and quotations from original source material.

The aim of the book is to guide the medical student in making an accurate diagnosis. Principles of logic and evaluation of data obtained from the history, physical examination and laboratory findings are discussed early in the book. Fallacies in, and unreliability of, many tests and procedures are emphasized. The student is admonished to use only tried and true methods. The importance of a carefully taken history is explained, and considerable emphasis is placed on the differentiation of functional from organic disorders.

The physical findings in various disease conditions are given in detail primarily in relation to the various anatomic regions of the body. The chapter on the nervous system contains several inaccuracies, although in general, the basic diagnostic procedures presented are of value in studying the more commonly seen neurologic disorders. The sections on the pulse, cardiovascular system and electrocardiography are most complete. The discussion of backache, posture and certain neuromuscular disorders is superficial.

One portion of the book is devoted to laboratory and special procedures. This section includes a detailed chapter on roentgenologic diagnosis and a fairly extensive consideration of the electrocardiogram. There is no mention of the various electrodiagnostic tests used in neurologic diagnosis, such as the electro-encephalogram, or the faradic and galvanic tests used in peripheral nerve or muscular disorders.

References to various important articles in the literature are included directly in the text. This arrangement is very helpful to the reader, but many of the references used have been superseded by more recent authoritative articles.

This book will prove primarily of value to the medical student as he is first learning the approach to clinical medicine. It cannot take the place of a more comprehensive work on differential diagnosis. However, it does present a brief introductory survey of diagnostic problems that may be encountered in general practice as well as the various specialty fields, and, for the most part, will provide the medical student with the basic principles of studying and evaluating various problems in clinical medicine.

FORENSIC MEDICINE. By *Keith Simpson,* M.D. Fabrikoid. Price, $4.50. Pp. 335, with 114 illustrations. William Wood & Company, Mt. Royal and Guilford Avenues, Baltimore 2, 1947.

The volume of Forensic Medicine by Keith Simpson of London is concise and to the point. The author modestly states, "this short textbook is designed to provide a brief and essentially practical guide — from an English school — to current teaching in Forensic Medicine." How well it does provide all that is claimed for it can be verified by reading the book. It is amazing how terse, and yet thorough, the wide field of forensic medicine has been incorporated in this one small volume.

The contents, naturally, and especially the laws as pertain to the English Compensation Acts, the schedule of industrial diseases, court attendance and conduct of the medical expert, the laws regulating the sale of poisons and the "Poison Rules," are largely based on medical-legal medicine from the British viewpoint.

The illustrations, while gruesome, are excellent and certainly emphasize the points stressed in the text. In the chapter on blood grouping and identification, mention is made of the "Rhesus factor" and P. H. factors in the identification of blood individuality, points not mentioned in some of our American texts. The main weakness of the book is in the fact that no bibliography is included, but this is easily overlooked in the general excellence of the volume. It should be read by everyone doing autopsy or medical-legal work.

PHYSICAL MEDICINE ABSTRACTS

Physical Fitness. Report of the Subcommittee of the Baruch Committee on Physical Medicine. Robert C. Darling; Ludwig W. Eichna; Clark W. Heath, and Harold G. Wolff.

J. A. M. A. **136**:764 (March 13) 1948.

Physical fitness describes the functional capacity of the individual for a task. It has no real meaning unless the task or job for which fitness is to be judged is specified. The fit individual can perform the task repeatedly without undue fatigue and has a reserve capacity to meet and sustain unexpected stresses which may arise. Because of the complexity of the concept and the wide variety of tasks carried on by different persons, universal standards for its evaluation are not feasible. Their establishment in any form would be a misleading oversimplification.

Physical fitness for a task depends on the physical equipment and physiologic competence of the subject for the stress which the task imposes, together with the complex psychologic factors grouped under the term "motivation." The physical and psychologic factors cannot be fully dissociated even in test procedures.

Since physical fitness involves more particularly a functional concept rather than an anatomic one, it is important that the physician be able to evaluate the functional capacity of his patient, whenever possible, by appropriate tests of working capacity and vasomotor response.

Since physical fitness is often governed by psychologic factors which overshadow the physical competence of the body, it is important for the physician to evaluate the total individual, with the help of the psychiatrist when necessary.

There is need for more data on physical capacity and physiologic adjustment in respect to age and sex factors, specific work situations in different environments, skills, strength and learning abilities in order to furnish guides to the physician in his judgment of a functionally normal body.

Dangers of Going to Bed. R. A. J. Asher.

Brit. M. J. **2**:967 (Dec. 13) 1947.

Asher stresses that the physician should think twice before ordering his patient to bed. He shows that rest in bed involves dangers to the respiratory system, blood vessels, skin, muscles and joints, bones, renal and alimentary tracts and nervous system. The author also directs attention to the demoralizing effects of staying in bed but admits that there is much comfort and healing in rest and that rest in bed is essential in many illnesses. His chief object was to disclose the evils of excessive rest, and he indicates how some of them can be avoided or overcome. He comments on the favorable effects of early rising after operations. He thinks that one way to avoid the dangers of bed lies in altering the equipment and arrangement of a ward. There should be a day room attached to every ward and lockers for patients' ordinary clothes. Too often patients stay in bed because, shuffling around in slippers and dressing gown, they are cold and uncomfortable. More liberal attention should be paid to breathing exercises, moving the limbs, and occupational therapy.

Comparison of the Effects of Mustard, Ultraviolet and X-Radiation, and Colchicine on the Cornea. Jonas S. Friedenwald; Wilhelm Buschke, and Sylvia G. Moses.

Bull. Johns Hopkins Hosp. **82**:312 (Feb.) 1948.

Some of the tissue reactions to x-ray, ultraviolet radiations, and colchicine have been compared with similar reactions to mustard. Among the agents compared, the effect of ultraviolet resembles those of mustard most closely, though with definite quantitative differences and with differences in relative susceptibility among various layers of corneal epithelial cells. If the mitosis inhibition produced by x-ray has any element in common with that produced by ultraviolet and mustard, then the effects of both types of agents compared, the effect of ultraviolet renot shared by the other. In the case of ultraviolet and mustard there may be some connection between the factors which lead to mitosis inhibition and those which lead to nuclear fragmentation, but nuclear fragmentation was not found in the corneal cells after x-ray in spite of marked inhibition of mitosis. Neither mitosis inhibition nor nuclear fragmentation appears to be directly connected with the loosening of the corneal epithelium nor with the increased NPN content of the cornea found after ultraviolet or mustard exposure.

Rheumatism and Arthritis. Committee Report. Philip S. Hench.

Ann. Int. Med. **28**:298 (Feb.) 1948.

Of the various treatments discussed for tenosynovitis Frank preferred rest and immobilization in acute cases, roentgenotherapy in chronic cases. Roentgen therapy was favored by Zander; in a case with both hips affected the symptoms and calcific deposits disappeared rapidly from the radiated side and remained unchanged on the untreated side. Immobilization in plaster or splints for five to seven days, then physical therapy for one to three weeks cured Cooper's 78 patients. According to Kaplan rapid relief was afforded by procaine.

Fibrositis is the most common form of acute and chronic rheumatism, but the term is "too loosely applied and ill-defined." Because of its variable manifestations "it marches under the false banners, assumes numerous disguises, and is known by a variety of aliases." The value of rest, heat, massage, salicylates and correction of postural defects were again noted. Rest is essential in acute cases. Skilled, heavy massage and "stretching" exercises were recommended. Such measures are effective even in "the fibrositis of old age."

Recent studies did not determine the disputed nature of para-articular calcification at the mesial aspect of the knee joint.

A Study of the Mechanism and Treatment of Experimental Heat Pyrexia. William M. Daily.

Am. J. M. Sci. **215**:42 (Jan.) 1948.

Heat pyrexia has been produced in laboratory animals (dogs, rats, mice) by exposure to high environmental temperatures. Except for differences related to the sweat mechanism and the more rapid course of events in smaller animals, the clinical picture of heat pyrexia in animals resembles closely that seen in man.

In the "pink stage" heat stroke is characterized by greatly increased cutaneous blood flow, amounting practically to an arteriovenous shunt with compensatory internal constriction. Cardiac output is high.

In the "gray stage" or stage of vascular collapse, generalized vasodilatation produces peripheral circulatory failure. Venous return and cardiac output fall. Despite continued need, oxygen consumption declines for want of transport. Anoxic damage is added to thermal damage in the body cells, generally.

Hyperthermia is reduced most rapidly, and with greatest advantage to the animal's chances for survival, by ice-bath. Fluids in moderate doses produced increased survival time in mice subjected to heat stroke. Massive intravenous infusions produced heart failure in rats during hyperthermia, while the same infusion was well borne by the rat at normal temperature. This indicates a definite reduction of myocardial reserve at excessive levels of body temperature.

Site of Action of Acetylcholine. Mortimer A. Rothenberg; David B. Springson, and David Nachmansohn.

J. Neurophysiol. **11**:111 (Mar.) 1948.

Giant axons of Squid were exposed to trimethylamine in 0.02M and to acetylcholine in 0.1M concentration, both labeled with N^{15}. After exposure, the axoplasm was extruded and the N^{15} concentration determined.

It was found that the tertiary base, trimethylamine, penetrates into the interior. After 25 min. exposure, 7.1 micromoles N were found per gram of axoplasm or 39.5 per cent of the external concentration. After one hour, the concentration was 15.9 micromoles N per gram as compared with 20 micromoles N per cc. outside.

Early Ambulation Following Major Surgery. Robert H. Bell.

Texas State J. Med. **43**:686 (Mar.) 1948.

Early rising and early ambulation promote more rapid convalescence through faster healing of wounds due to increased circulation and muscle activity. Fewer postoperative accidents such as thrombophlebitis, pulmonary emboli, illeus, and so forth, are observed. The patients look better and have a better mental outlook. Some contraindications to early rising are shock and active bleeding. A detailed plan for use in early ambulation is presented.

Observations on Electrical Stimulation of Pain Fibers in an Exposed Human Sensory Nerve. R. E. Pattle, and G. Weddell.

J. Neurophysiol. **11**:93 (Mar.) 1948.

Condenser shocks were applied to an isolated human digital nerve, in which, following the injection of a local anesthetic into the region, only a few fibers appeared to respond to stimuli. The only sensation which could be produced was that of pain which was felt after a delay of 1.25 seconds following the application of the stimulus. It is suggested that at least part of this delay is due to central and not peripheral factors.

The voltage threshold necessary to elicit pain was determined for a number of condenser discharges of different time-constants. The values so obtained are in satisfactory agreement with the theoretical voltage condenser time-constant curve of Hill, the time-constant "k" being about 6.5 milliseconds.

The possibilities that one condenser shock gives rise to repetitive impulses in the nerve, and that pain is due to the temporal summation of impulses which singly would not cause pain, have been discussed, and rejected.

Observations on Sensory Paralysis Produced by Compression of a Human Limb. D. C. Sinclair.

J. Neurophysiol. **11**:75 (Mar.) 1948.

As a result of study of the sensory changes following the application of pressure to the intact human arm, Lewis, Pickering and Rothschild put forward the view that "sensory nerve fibers become sensitive to ischaemia as they are traced back from their endings towards the central nervous system."

This work has been repeated, using a more critical technic, and it has been found that the generalizations on which the theory is based do not survive a close examination. It is possible, however, to explain all the experimental observations in terms of currently accepted physiologic principles, by a consideration of some of the anatomical factors involved in compression of the upper limb.

In the course of the investigation it was found that the mechanism of the sensation of touch aroused from the skin appears to be more susceptible to the effects produced by compression of the limb than that aroused from hairs. It is

possible that the sensory endings may have some influence in modifying the manner in which the various sensory modalities are lost in compression experiments.

Fractures of the Tibial Condyles Involving the Knee Joint. Edwin F. Cave.

Surg., Gynec. & Obstet. **86**:289 (March) 1948.

Whether plaster immobilization or suspension in a hinged splint should be used after operation is optional. It is believed that if the fracture or fractures have been well stabilized by the bolt, suspension is sufficient. Early exercises can be carried out in the splint and at the end of a six weeks' period, the patient is allowed up on crutches, and with little weight-bearing in a light hinged brace to prevent any tendency to valgus deformity of the knee.

If the fracture is a simple, not a comminuted one, it is possible that manipulation and compression, followed by plaster, will be sufficient. For the minor displacements, manipulation and plaster fixation may improve the situation. As in all fractures of weight-bearing joints, delayed weight-bearing must be practiced. Crutches must be used for a period of two to six months, depending on the severity of the injury. Any tendency to valgus position of the knee must be prevented by the use a hinged brace and Thomas heel.

Vitamin D_2 in the Treatment of Lupus Vulgaris.

For. Letters, J. A. M. A. **135**:528 (Oct. 25) 1947.

Vitamin D_2 in an alcoholic solution, given per os, is claimed to cure completely and definitely tuberculosis of the skin. As stated by Professor Robert Debre at the scientific assembly of the Centennial Celebration of the American Medical Association, signs of intolerance through too strong doses have been seen. At one of the recent meetings of the National Academy of Medicine, J. Charpy (Dijon) has explained the results of his research on the process of action of vitamin D_2; he thinks that a certain amount of vitimin D_2 increases the activity of intestinal phosphatases and that with stronger doses there occurred, moreover, activation of other phosphatases in the kidneys and in the bones, which produced intoxication.

Fractures Disabilities. Merritt L. Jones, M.D.

Wisconsin M. J. **47**:207 (Feb.) 1948.

In caring for a so-called Pott's fracture, three common errors in treatment should be recognized and avoided, namely, (1) failure to close the ankle mortise, (2) lack of dorsiflexion due to shortening of the heel cord, and (3) distortion due to too early weight-bearing. The use of a walking iron during immobilization is highly recommended.

One of the most disabling fractures in the foot is that of the os calsis. Many methods of reduction have been advocated. Whatever method is used, restoration of the salient angles is mandatory.

The author stresses the importance of physical therapy, not only as a necessary adjuvant to the follow-up treatment of fractures, but one which should be instituted and supervised throughout the convalescence of the patient. The ability of any physician undertaking the treatment of fractures and the success of the various types of treatment are best judged by end results. Function is paramount. Function plus accurate reduction and union is the result one tries to obtain.

New Walking Rocker for Fractures Below the Knee. Reece R. Boone, Jr.

Bull. U. S. Army M. Dept. **7**:324 (April) 1948.

The rocker was so designed as to bring the apex of the convexity of the rocking surface in the weight-bearing line of the extremity. This permits a rocking motion toward the toes, closely simulating the normal motions of walking, and permitting a steady, uninterrupted gait. The construction of this rocker is almost as simple as that of the conventional walking iron. Its chief advantages are ease and comfort in walking and the attainment of a normal gait. It also shortens convalescence, because the necessity for rehabilitation in attaining a normal gait is practically eliminated.

New Trends in Hospital Design. Paul Haun, and Z. M. Lebensohn.

Am. J. Psychiat. **104**:555 (Feb.) 1948.

In a 1,000-bed general medical hospital, there would be 280 beds on the neuropsychiatric service consisting of 80 neurologic, 80 convalescent and 120 psychiatric beds.

The service is best located on consecutive floors of the hospital to give greater cohesion to its administration. Although other locations are feasible, the topmost floors seem most desirable, since in such a location the behavior of overactive or noisy patients does not become a hospital nuisance. The patients have direct and easy access to a roof garden which, because of its height, insures complete privacy. The hydrotherapy unit should be located on the floor with the disturbed patients who will be using it most. The preferred arrangement would allow disturbed patients to enter it directly from the nursing unit while patients from other nursing units would use a lobby entrance.

The hydrotherapy department in the hospitals contemplated would consist of more than merely applying water as a cure. There is a definite element of group therapy involved when 10 to 15 disturbed patients are brought to the hydrotherapy suite for treatment. The punitive aspect of placing a patient in a pack or in a tub is avoided. The patient does not feel that he is being singled out for specialized treatment, and a group of patients in hydrotherapy quiet down remarkably well even in a large room. Psychotic patients not infrequently attribute much of their improvement to these treatments. In addition, there is

great advantage in placing all hydrotherapy under the control of one skilled therapist. When tubs are placed throughout the hospital on the various nursing units they are rarely used. This results in a great waste of space and equipment. One skilled hydrotherapist and his corps of assistants can, by scheduling patients, treat all those who require hydrotherapy in an admission and treatment building or a disturbed building in the course of a day. Night-time emergencies can be handled readily enough in single rooms on the nursing units by personnel who have rotated through the hydrotherapy service.

The location of the hydrotherapy department is a point of very real importance. The authors are dedicated to the idea of getting hydrotherapy out of the basement and placing it on the floor nearest the disturbed patients who need it most.

There should be separate units for sedative hydrotherapy (consisting of pack tables and tubs) and tonic hydrotherapy, which consists of stimulating needle showers and douches. The latter is best located on the ground floor near the exercise room and outdoor exercise areas where it may be most effectively used.

The sedative hydrotherapy unit, like the cafeteria, should be centrally located and, if possible, so placed that disturbed patients may have access to it without going into the public lobby. However, there should also be access to the suite from the public lobby so that patients from other wards may enter the unit without traversing the disturbed section.

The typical sedative unit should consist of four sections: (1) a small hydrotherapist's station or office, with trilateral observation into (2) a dressing room, (3) a pack-room containing 10 to 12 tables, and (4) a tub room containing 4 continuous-flow tubs. There should also be room for blanket driers, storage closets, toilets and cleansing showers.

Treatment of Rheumatoid Arthritis. W. S. Tegner.

Lancet **6500**:469 (March 27) 1948.

The treatment of rheumatoid arthritis can be discussed under two heads: (1) general nonspecific therapy to build up the general health, increase the weight, strengthen the muscles, prevent deformity and maintain mobility; and (2) drugs aimed specifically at the disease process.

Local rest for the affected joints must also be prescribed. There is always the bogy of contracture, deformity and crippling looming up in the vision of the rheumatoid arthritic. Deformity and crippling are the results of muscle spasm and these spastic muscles must be relaxed and rested.

One is prone to disregard the lessons on body mechanics taught by Goldthwait, who drew attention to the correct position in which patients should be nursed in bed, and the importance of permitting and encouraging adequate chest expansion.

The sitting position is dangerous in rheumatoid arthritis, and patients must be taught to keep their knee-joints extended rather than flexed.

Our most potent weapons against rheumatoid arthritis are rest and non-specific physical therapy. Some say that this is not treatment at all but merely palliation and they would probably advocate specific treatment claimed to be directed against the cause of the disease.

Sequelae of Local Exposure to Cold. D. R. Webster.

Canad. M. A. J. **58**:258 (March) 1948.

The treatment of the patients had to be individualized. One must observe the objective signs and carefully evaluate the response to therapy. The essence of treatment is time. It must be realized that these disabilities are of long duration, but given sufficient time will undergo a certain amount of resolution that will enable patients to carry on their former employment, especially if it be one of sedentary character. This process may be slow and extend over a period of years. Physical therapy will help these patients considerably; such treatment as general reconditioning and specific efforts directed towards the atrophy of the intrinsic muscles of the feet and the concomitant small joint stiffness. Efforts should also be made to improve the local circulation by such methods as active exercise and wax baths.

What Every Medical Officer Should Know About the Atomic Bomb. IV. Evaluation of the Five Atomic Explosions.

Bull. U. S. Army M. Dept. **8**:350 (May) 1948.

Air-burst atomic bombs will produce lethal effects over an area of two square miles and measurable effect over an area of seven square miles as a result of the prompt gamma radiation emitted at the time of detonation. The residual radioactivity is of little importance except in the area close to the center of a low-altitude explosion. In an underwater detonation, radioactive fission products and unfissioned material will be spread by the cloud and base surge over a large area. The gamma radiation from these materials will be lethal to exposed personnel more than two miles downwind, and serious contamination will result at much greater distances. This contamination will provide a serious hazard for an indefinite period. Prompt evasive action at the time of the detonation will permit the reduction of casualties, and orderly evacuation and re-entry procedures will undoubtedly pay great dividends in minimizing the effects.

The pathologic effects of radiation can best be presented by outlining the early and late changes in (1) tissue cells, (2) organ systems, (3) total body irradiation and (4) internal radiation by radioactive materials introduced into the body either accidentally or therapeutically. Sensitivity of the various body tissues has been well established, and has been expressed largely as the relation of one tissue to another.